

ED-2002-59
29 March 1967

APOLLO APPLICATIONS PROGRAM (AAP)
PAYLOAD INTEGRATION

Technical Study and Analysis Report

MISSION FEASIBILITY ANALYSIS, AAP
UNASSIGNED MISSIONS

Contract No. NAS8-21004

CONTENTS

Page 1

	<u>Page</u>
Contents	1
1. INTRODUCTION	1-1
2. CONCLUSIONS.	2-1
3. ANALYSIS APPROACH.	3-1
3.1 Objectives.	3-1
3.2 Method of Analysis.	3-1
3.3 General Ground Rules.	3-2
4. MISSION CARRIERS	4-1
4.1 Description of the Carriers	4-1
5. AAP MISSION 5/6/7/8.	5-1
5.1 Mission Plan.	5-1
5.2 Configuration	5-1
5.3 Ground Rules.	5-1
5.4 Experiments	5-2
5.5 Analysis Results.	5-2
5.6 Problem Areas	5-4
6. AAP MISSION 9/10/11/12/13/13A.	6-1
6.1 Mission Plan.	6-1
6.2 Configuration	6-1
6.3 Ground Rules.	6-2
6.4 Experiments	6-3
6.5 Analysis Results.	6-3
6.6 Problem Areas	6-5
7. AAP MISSIONS 17/18 and 36.	7-1
7.1 Mission Plan.	7-1
7.2 Configuration	7-1
7.3 Ground Rules.	7-1
7.4 Experiments	7-3
7.5 Analysis Results.	7-3
7.6 Carrier Add-Ons and Problem Areas	7-9
8. MISSIONS 19/20/21/22 or 23/24.	8-1
8.1 Mission Plan.	8-1
8.2 Configuration	8-1

CONTENTS (Continued)

	<u>Page</u>
8.3 Ground Rules	8-1
8.4 Experiments	8-4
8.5 Analysis Results	8-4
8.6 Problem Areas	8-7
9. AAP MISSION 25/26/27/28/29	9-1
9.1 Mission Plan	9-1
9.2 Configuration	9-1
9.3 Ground Rules	9-1
9.4 Experiments	9-4
9.5 Analysis Results	9-4
9.6 Problem Areas	9-6
10. AAP MISSION 30/31/32/33/34	10-1
10.1 Mission Plan	10-1
10.2 Configuration	10-1
10.3 Ground Rules	10-1
10.4 Experiments	10-3
10.5 Analysis Results	10-4
10.6 Problem Areas	10-5
11. AAP MISSION 523	11-1
11.1 Mission Plan	11-1
11.2 Ground Rules	11-2
11.3 Configuration	11-3
11.4 Carrier Capabilities	11-3
11.5 Problem Areas	11-3

1. INTRODUCTION

The purpose of this report is to summarize the results of various investigations which were made of the proposed AAP missions given in the NASA "Guidelines for Payload Integration - Phase D Proposal" (Revision A dated 7 March 1967). The investigations were made to assess the gross feasibility of performing the missions as presented in the proposal guidelines.

General mission plans and analysis ground rules for each mission, of MSFC integration responsibility, were prepared. Specific system requirements for each mission were tabulated and compared with the capability of existing carriers and equipment assigned to the mission or flight. Mismatches in the capability versus the requirements were tentatively solved by adding or deleting "type" equipment. The analysis was terminated with the preparation of weight statements, inboard profiles, and documentation of what specific problems would have to be solved in order to achieve mission feasibility.

A gross program level estimate of the capability of existing GSE and facilities to support these AAP missions was also made.

The succeeding sections of this report contain conclusions and recommendations resulting from the analysis; a brief description of considered mission carriers/vehicles; and the analysis summary of the missions including weight statements, profiles, and significant problems.

2. CONCLUSIONS

The missions considered by this report are thought to be feasible when the problems identified by the report have been resolved.

Table 2.1 presents a summary of the analyzed missions for the resultant performance parameter of weight. The following conclusions summarize the feasibility assessment for each of the type missions covered by the report.

2.1 Low Earth Orbit Missions (See Paragraphs 5.6, 6.6) - Most of the low earth orbit missions must solve the problem of insufficient boost capability for the desired payloads. This excessive weight problem can be resolved by any or a combination of the following means:

- a. Increased booster capability.
- b. Lower orbital requirements when consistent with experiment and operational requirements.
- c. Selection of more weight advantageous system hardware or development of new systems, along the same guidelines, for follow-on missions.
- d. Optimization and development of experiment equipment commonality where applicable.
- e. Selection and development of a more efficient means for life support commodity and resupply storage, especially for the longer duration missions.
- f. Reassignment of non-flight critical mission components to mission flights with positive payload margins.

The problem of equipment qualification for life extension consistent with the expected low earth orbit environments must be solved if mission success is to be realized.

Much further analysis must be accomplished to fully assess the ability of the crews to perform the planned missions. This analysis, coupled with additional crew safety considerations, will undoubtedly increase equipment and performance requirements beyond those presently identified.

Methods for elimination of crew motion, contamination, and thermal effects on experiment performance must be devised. Environmental hazards to the crew and mission systems must be eliminated by thermal, radiation, and meteoroid protection design reevaluation and possible redesign.

2.2 Synchronous Orbit Missions (See Paragraph 7.6) - The ability to place the desired mission payloads in proper orbit does not appear to be a significant problem at this time. The protection of the crew, systems, and experiments from the deep space environments, including trapped radiation and solar flare appear to be the significant problems which must be overcome to achieve mission success.

Optimization of the mission payload to obtain the most value from the mission systems and equipment has not been achieved for these missions in terms of time and payload usage.

System life, from the standpoint of prelaunch operation, flight operation, and expected reactivation requirements, must be extended beyond that presently known in almost all areas.

The problems mentioned in paragraph 2.1, with the exception of weight, are also applicable to the synchronous orbit missions.

2.3 Lunar Landing Missions (Shelter) (See Paragraph 8.6) - The ability to land the required operational and experimental equipment for these missions with the existing scheme is one of the significant mission problems. Landing site locations must be selected before much further analysis along these lines can effectively proceed.

Optimization of the mission configuration can be achieved when the manned mission portion time of performance is determined. Realignment of the shelter thermal system sizing and arrangement must be updated to reflect increasing manned phase operational requirements.

The ability of the crew to perform the required operations, using presently known equipment and procedures, is severely taxed and must be revised and realigned by further analysis. The method of RTG integration and operation during the mission must be determined.

Optimization of selection and return, to earth, of the scientific payload as a requirement must be accomplished.

2.4 Ground-Outfitted Workshop Low Earth Orbit Missions - These missions have the same problems discussed for low earth orbit missions (Paragraph 2.1) except that the boost capability exceeds the present payload weight requirements. Much additional analysis is required to better approximate the MMWS requirements for the total mission duration. Optimization of experiment payload has not yet been approached.

Life support and other commodity storage for the mission duration is a significant problem which must be resolved.

2.5 Voyager - This mission, using the present ground rules, does not present significant problems to an integrating contractor. The significant mission problems which exist for this mission are not detailed as a portion of this report.

2.6 Facilities & GSE - The AAP is a dynamic program in the sense that it is undergoing a continual process of development as the concepts of individual flights and missions are being evolved. Because of this, facility and GSE requirements will likewise undergo a continual evolution to meet the changing need. Within the current framework of AAP definition, however, the incorporation of the facility requirements needed to support the flights 1 through 4 payload integration and prelaunch activities will have provided the great bulk of these same requirements needed for the continuing AAP, flights 5 through 37. Areas of concern involve additions, rearrangements and modifications to the utilization of space, equipment, utilities, commodities, technical support laboratories, industrial support areas, etc. Since the AAP is to make maximum use of the Apollo support facilities and GSE, an additional important element is the schedule impact upon utilization of all facilities. The nature of additional requirements upon the support facilities of specific locations is delineated briefly in the following paragraphs.

2.6.1 Marshall Space Flight Center - Expansion of the Payload Integration Facility (PIF) and supporting test areas is required for accommodating the LM and LM derivatives, LM/ATM/Project Thermo, LM/LSSM and MMWS.

2.6.2 Kennedy Space Center

- a. Relatively minor modifications of work and integration areas and experiment accommodation areas are required in the MSOB and in some supporting technical laboratories and test facilities in the Industrial Area to support LMSS, Project Thermo, fuel cells, RTG and new experiments.
- b. Incorporate work area and test support facilities in the VAB low bay area for the MMWS and associated systems and GSE.
- c. Incorporate support provisions in the Saturn V high bay area of the VAB for checkout of AAP carriers and experiments which are not included in basic Apollo configurations. Major involvement concerns space, power and commodities for checkout and servicing GSE, none of which are expected to make extensive demands upon existing provisions.
- d. The support provisions of LC-34 and LC-37B substantially satisfy the requirements of the continuing AAP with minor modifications of space, power and commodities utilization if subsequent Saturn IB spacecraft configurations remain oriented to the launch complex in the same manner as for flights 1 through 4. If schedule limitations should prevent this, duplicate supporting facilities and GSE would be needed on LC-34 and LC-37B.
- e. Launch Complex 39 requires modification of supporting facilities and GSE to provide cryogenic liquid and gaseous servicing, venting capability, electrical power, controls and instrumentation, environmental control, etc., for support of servicing and checkout GSE for the carriers and experiments which are AAP delta beyond Apollo configurations.
- f. The extent of the servicing and test support requirements which the Interplanetary Flight Module (IFM) will demand of the Saturn V facilities and GSE is not established. Details will evolve from continuing examination and analysis of the developing interface definitions.

2.6.3 Mission Support Facilities - The expansion of mission support facilities and GSE (MCC-K, MCC-H, HOSC, MSFN, MSCC, recovery facilities, etc.) to handle the requirements of AAP flights 1 through 4 should substantially satisfy the requirements of the continuing AAP flights. Minor modifications may be needed to support the unique requirements of some carriers and experiments.

TABLE 2.1
AAP MISSION PAYLOAD SUMMARY

FLIGHT	VEHICLE	ORBIT N MI, AZ°	CARRIER/WT	GROSS VARIABLE WEIGHT	EXPERI- MENTS	PAY- LOAD	P/L CAPA- BILITY	FLIGHT MARGIN
5	212	80 x 220 to 200, 28.9°	LCSM/22420	12,357	843	39,480	38,407	-1,074
6	213	220, 28.9°	Rack/ 2144 IU/23	0	20,538	27,873	29,307	1,433
7	214	80 x 220 to 200, 28.9°	LCSM/22420	12,125	541	38,946	38,407	-540
8	215	80 x 220 to 220, 28.9°	LCSM/22420	12,125	829	39,234	38,407	-828
9	216	80 x 260 to 260, 28.9°	LCSM/21594 Rack/2892	9,057	4,589	41,992	37,707	-4,286
10	217	260, 28.9°	AM/14368 MDA/3426 OWS/2384	219	463	26,028	26,307	277
11	218	260, 28.9°	ATM/13844 LM/3774	1,090	1,779	25,654	25,907	251
12	219	80 x 260 to 260, 28.9°	LCSM/22420	12,125	395	38,800	37,707	-1,094
13	220	80 x 260 to 260, 28.9°	LCSM/22420	12,125	394	38,799	38,407	-393
13A	221	260, 28.9°	LCSM/22420	12,125	185	38,590	38,407	-184
25	517	220, 50.0°	LCSM/21443 MDA/15561 MM/83860	24,824	13,388	162,886	209,700	46,814
26	222	80 x 220 to 220, 50.0°	LCSM/21443	7,824	518	33,705	35,307	1,601
27	223	220, 50.0°	LM/4888 Rack/8290	8,108	2,719	29,172	30,007	8,833
28	224	80 x 220 to 220, 50.0°	LCSM/21443	7,824	1,050	34,177	35,307	1,129
29	225	80 x 220 to 220, 50.0°	LCSM/21443	7,824	741	33,868	35,307	1,438
30	521	220, 50.0°	LCSM/21443 MDA/15561 MM/83860	24,755	1,486	150,965	209,700	58,734
31	226	80 x 220 to 220, 50.0°	LCSM/21443	7,824	559	33,686	35,307	1,620
32	227	80 x 220 to 220, 50.0°	LCSM/21443	7,824	947	34,101	35,307	1,705
33	228	80 x 220 to 220, 50.0°	LCSM/21443	7,824	583	33,710	35,307	1,596
34	229	80 x 220 to 220, 50.0°	LCSM/21443	7,824	229	33,356	35,307	1,950

TABLE 2.1 (Continued)
AAP MISSION PAYLOAD SUMMARY

FLIGHT	VEHICLE	ORBIT N MI, AZ ^o	CARRIER/WT	GROSS VARIABLE WEIGHT	EXPERI- MENTS	PAY- LOAD	P/L CAPA- BILITY	FLIGHT MARGIN
17	513	Sync 19350, 28.9 ^o	LCSM/21534 AM/10447 MDA/3376	24,403	1,138	64,758	71,247	6,488
18	514	Sync 19350, 28.9 ^o	LCSM/21443 ATM/13947 LM/3602	23,982	2,172	69,573	71,247	1,673
36	522	Sync 19350, 28.9 ^o	LCSM/21815 ATM/13803 LM/3730	25,071	1,992	70,271	71,247	974
19	515	80 to Lunar, 171.0 ^o	CSM/20059 LM Shelter/10510	57,837	3,595	95,861	94,083	-1,779
21	519	80 to Lunar, 171.0 ^o	CSM/20059 LM Shelter/10510	57,837	3,595	95,861	94,083	-1,779
23	524	80 to Lunar, 171.0 ^o	CSM/20059 LM Shelter/10510	57,837	3,595	95,861	94,083	-1,779
37	523	80 to Int. Plan	Voyager/41000	14,300	744	56,044	60,000	3,956

3. ANALYSIS APPROACH

3.1 Objectives - The objective of the analysis sections of this report is to generate sufficient data by integrating experiments into the missions beyond flight 4 so that experiment subsystem mismatches and major problem areas are defined. This analysis also recommends AAP subsystem add-on modules which can compensate for the mismatches caused by integrating experiments and other requirements into the various AAP carriers.

3.2 Method of Analysis - The following approach was used for the analysis contained in this report:

3.2.1 The NASA proposed experiments were analyzed to determine their requirements and characteristics. The experiments were assigned to locations (flights) within the applicable mission.

3.2.2 A matrix (Summarized in Table 2.1) was prepared which allocated baseline carriers to the various flights which best satisfied NASA's "Guidelines for Apollo Applications Payload Integration Phase D Proposals".

3.2.3 The support requirements for each of the experiments for a particular vehicle and mission were determined.

3.2.4 The mission plans, defined in the General DRMD-ED-2001, were used to determine the mission ground rules and operational requirements.

3.2.5 The operational and experiment requirements were integrated to determine the total mission requirements.

3.2.6 An assessment of the mission assigned baseline carrier capability, in terms of the major systems, was made and tabulated.

3.2.7 A "shopping list" of existing, developed, and qualified components and systems was prepared as a source for system add-ons.

3.2.8 The total mission requirements were compared to the baseline carrier system capabilities. This comparison resulted in system mismatches, predicated upon the assessed mission requirements.

3.2.9 The mismatches were analyzed on a system level to select the most likely add-on modules (shopping list) which could satisfy the requirements/capability mismatch.

3.2.10 Weight statements and inboard profiles were prepared to summarize the analysis.

3.2.11 Significant problems, discovered in the course of each mission analysis, were defined in terms of performance and environment.

3.3 General Ground Rules

3.3.1 The baseline carrier configurations for this study will be as generally described in Section 4 of this report.

3.3.2 The baseline configuration for the MDA is as contracted for by MAC. The MDAs used in conjunction with the LCSMs will not contain the cylindrical section between the radiator and the docking cross.

3.3.3 There will be no resupply module (RM).

3.3.4 During all mission phases, the three astronauts shall have continuous communication capability with each other.

3.3.5 Data management, transmission and communication requirements shall remain within the existing ground station network capabilities.

3.3.6 Temperature and hazard monitoring systems, with visual and auditory warning devices, shall be available and used to warn the crew of out-of-tolerance conditions or hazards on each on-orbit vehicle. The crew can then take appropriate action if a hazardous condition is identified.

3.3.7 Life support EVA umbilical outlets, provisions for PLSS, and an airlock shall be provided for earth orbit missions requiring EVA.

3.3.8 The experiment data return capability of the CM shall be limited to a net weight of 800 pounds and a net volume of 30 ft³. An additional 266 pounds and 8.25 ft³ is available for boxes, containers, canisters, refrigerators and support structures thereof. These figures are based on a "stripped" 3-man crew CM (Ref. NAA report #SID 66-773, Command Module Return Payload Capability, 26 May 1966).

3.4 Mass Property Method and Definition

3.4.1 Payload weight statements, detailed weight statements, and assumed experiment weights are included in this report for each analyzed mission. These weight data are preliminary projected values intended only to assist in evaluating mission feasibility.

An 1130 computer was used to prepare the weight statements. (Note: This computer converts base ten input to Binary and then drops any decimal value. This causes an error of one part in 1000 in the machine which resultingly appears as a one pound error on the printed weight statements. The errors were considered negligible for this report and corrections were not made to the weight tables.)

3.4.2 The following statements provide some insight into how the weight tables were derived.

- a. The gross experiment weights include an allowance for mounting and packaging which is listed in the detail experiment tables.
- b. Payload weights include structure such as SLA.
- c. All flights contain Martin Marietta weight values for evaluation of the crew provision and life support requirements.
- d. The CSM weight includes a growth (MSFC) value which was obtained by comparing North American Report No. SID 65-1532 (Enclosure 5) to the latest MSFC CSM Weight Statement. This growth value was also used to define the LCSM baseline weight.
- e. The MMWS weights are based on preliminary configuration information coupled with present knowledge of the OWS. The MMWS weight values should be considered as gross estimates.
- f. The LM Shelter weights were obtained from Grumman Reports and updated with U. S. Government Memorandum PM2-MS4.

g. The Voyager Mission includes a detailed experiment list and a gross injected weight statement. Since adequate information concerning payload capability is not available, a payload weight margin was essentially assumed.

3.4.3 Definitions

Injection Capability to Initial Orbit is defined as the maximum weight that the booster can carry for the prescribed flight and mission requirements.

Payload Capability at Launch is defined as that part of the orbital weight which is above the Instrument Unit (I.U.). Flights 25 and 30 are exceptions to this definition in that their payload capability at launch weight includes everything above the SII stage.

Payload Margin is the amount of weight remaining or not remaining as a capability for the projected flight.

Variable Load includes the following weight classes: Main Tank Usable, Reserve, and Residual Propellants; RCS Usable, Reserve, and Residual Propellants; Crew; Crew Personal Equipment; Life Support Equipment and Special Accessories, Oxygen, Water, CO₂ Removal Equipment, LiOH, Food, and Miscellaneous as applicable. (Environmental and Electrical Cryogenics are totally included as required.)

4. MISSION CARRIERS

4.1 Description of Carriers - The baseline configuration for each carrier considered in this report is as follows:

4.1.1 Command and Service Module - The Block II CSM was used. This carrier has a 14-day capability which may be extended to longer mission times by installing commodities in Sector I and other areas of the Service Module.

4.1.2 90 Day Command and Service Module (LCSM) - This carrier is a modified Block II CSM which serves as a crew transit vehicle and resupply module. While on orbit (in a cluster), the LCSM is essentially dormant, and requires only 660 watts of electrical power from the workshop solar array. The Block II fuel cells and electrical power supply system is replaced by a battery system with a capacity for 7 days normal operation. Food and LiOH supplies are for 7 days only. Two of the SPS propellant tanks are deleted and a solid rocket package is added as the primary retro back-up. While on orbit with a cluster, the guidance and navigation system is dormant. The space gained by removing SPS propellants and EPS reactants can be used for resupply commodities.

4.1.3 Lunar Module Ascent Stage - For lunar landing missions a standard LM ascent stage is used. When used for non-lunar missions, the LM ascent stage is modified by removing the main propulsion system. The vehicle has life support capabilities for two men for two days.

4.1.4 LM Shelter - The LM shelter configuration is described in Grumman Company report "LEM Shelter Design Analysis Summary," dated 8 December 1965 (Vol V) and as shown in Paragraph 8.3 of this report.

4.1.5 Rack - The rack is a structure similar to that defined by NASA drawing 37-B-1-112, "Experiment Rack, Basic Dimensions," which consists of an upper and lower structure. The lower structure, which mounts to the LM/SLA attach points, is used in place of the LM descent stage and can be used to mount experiments, support subsystems and resupply commodities. The upper structure adapts the total rack structure for docking with the command module during orbital operations.

4.1.6 Airlock Module and S-IVB Stage OWS - The airlock module is defined in NASA document GP-102, "Statement of Work Contract NAS9-6555-Airlock." The S-IVB spent stage orbital workshop is defined in Specification CP 2080XXX, "S-IVB Stage for Use as Orbital Workshop."

4.1.7 Instrumentation Unit - The standard Saturn IU is used.

4.1.8 Multiple Docking Adapter - The MDA for orbital activated workshop configurations is defined in Martin document RS 200000, "General Specification for Performance and Design Requirements for the Saturn Apollo Applications - Combined Missions - Rev. 1." For ground-outfitted workshops the MDA is modified by removing the cylindrical section aft of the docking cross. The modification results in a shorter MDA and provides room for the SM SPS engine bell in the SLA.

4.1.9 Mission Module Workshop - The MMWS is a modified basic S-IVB stage structure that is ground-outfitted with levels and compartments to serve as a laboratory, sleeping and living quarters, a crew conditioning area, and command post. Storage facilities are provided internally and externally to the structure and accommodate a 360 day supply of personal hygiene, food, medicine, and other consumables and expendables required for the mission. The MMWS will provide an environment that is compatible for a year of crew habitation and mission requirements.

5. AAP MISSION 5/6/7/8

5.1 Mission Plan - This is a low earth (220 n. mi. circular - 28.9° inclination) orbit mission using AAP vehicles 5, 6, 7 and 8. The mission objectives and general mission profile are given in the General DRMD, Document ED-2001.

5.2 Configuration - Flights 5, 7 and 8 are similar and consist of a Saturn 1B launch vehicle and an LCSM. Flight 6 consists of a Saturn 1B launch vehicle (with nose cap), and an experiment rack. Fig. 5.2 shows the general layout of Flight 6 and Tables 5-4.1 through 5-4.12 show the estimated weights for the four flights.

5.3 Ground Rules - The following ground rules were used for the analysis of Mission 212/213/214/215 (Flights 5, 6, 7 and 8).

- a. The baseline for the AM is in Proposal Statement of work GP-102 (19 August 1966).
- b. The mission will use experiments left in orbit from AAP Flights 3 and 4, plus other experiments brought to the cluster by the mission flights.
- c. Existing cluster umbilicals for H_2 and O_2 will be used to transfer N_2 and O_2 from the SM of the LCSM to the AM. The existing electrical power umbilical (between SM and AM) should be considered for transferring power between the AM and SM.
- d. EVA equipment will be placed in orbit with initial flights. Refurbishing commodities for EVA will be brought to the cluster by LCSMs.
- e. For unmanned Saturn 1B flights, the payload will be injected directly onto the final circular orbit by the S-IVB stage.
- f. Orbital decay will not be considered as a means of increasing the payload brought to a cluster by subsequent flights.
- g. The experiment list (42-1017-1) Rev. 2 dated 20 March 1967, will be the basis for all LEO flights.

h. S-IVB stages are not restartable.

i. No resupply module will be used.

5.4 Experiments - Flights 5, 6, 7, and 8 will each bring experiments into orbit. In addition, experiments in OWS-1 will be reactivated. Tables 5.4-3, 5.4-6, 5.4-9, and 5.4-12 contain the grouping of experiments to be performed during each of the four flights, defined as to launch and performance location. One experiment of those given in the NASA Proposal Guidelines (M402) was not carried because it does not appear to be desirable or necessary for satisfactory reactivation of OWS-1.

The experiment requirements per the flight groupings were tabulated as a means for evaluating the capability of the mission systems to perform the experiment list (paragraph 5.5).

5.5 Analysis Results - The subsystem capabilities of the following carriers for support of this mission were assessed.

<u>Carrier</u>	<u>AAP Flt. No.</u>
Instrument Unit (IU)	5
LCSM (Command Service Module)	5
Instrument Unit (IU)	6
Rack (Experiment)	6
OWS-1/AM/MDA/IM&SS	1-2
IM/ATM	4
Instrument Unit (IU)	7
LCSM (Command Service Module)	7
Instrument Unit (IU)	8
LCSM (Command Service Module)	8

These capabilities and the experiment and operational requirements were compared to determine the areas of incompatibility which will have to be resolved in order to satisfactorily perform the planned mission. The identified incompatibilities are given in Tables 5.5-1 through 5.5-10 with the suggestion of a system add-on (or deletion) which can solve the problem.

The following paragraphs summarize the analysis results by major system discipline.

5.5.1 Electrical Power - The LCSM is defined as a Block II CSM with its fuel cell system replaced by a battery system capable of 7 days operation and having a 90 day wet stand time. Ten (10) Eagle Pitcher Batteries (P/N 4194) are used for this purpose.

The solar array on the LM/ATM and OWS-1, which were sized for the first cluster mission (AAP 1, 2, 3 and 4) appear adequate for the electrical loads of this mission.

5.5.2 Data Management - Only the IU of Flight 6 requires a change to the baseline configuration. The experiment rack on Flight 6 imposes the requirements shown in Table 5.5 to make it compatible with experiment requirements.

5.5.3 Guidance and Control - No changes are required for the baseline configurations for Flights 5, 7 and 8. The rack (Flight 6) must supply guidance and control subsystem support for EMR and EO experiments. Support requirements are listed in Table 5.5-4. The RCS propellant requirements are summarized in Table 5.5-11 which shows that the RCS capability of the LCSMs for Flights 5 and 7 are marginal.

5.5.4 Thermal Control - No changes are required to any of the baseline configurations.

5.5.5 Propulsion - The LCSM is defined as a Block II CSM with two SPS propellant tanks removed. The only change to this baseline propulsion system is the addition of patch-type heaters to the RCS engine clusters and to the propellant lines of the SPS. The teflon bladders in the RCS tanks must be replaced with a material that is compatible with 90 day mission requirements.

5.5.6 Communications - No changes are required to any of the baseline configurations.

5.5.7 Display and Controls - Display and Control panels must be added to the launch configurations of the CSMs of Flights 5, 7 and 8 and to the rack of Flight 6.

5.5.8 Life Support - The ninety-day support requirement is satisfied by using the CSMs of Flights 5, 7 and 8 as resupply vehicles. Tables 5.5-2, 5.5-8 and 5.5-10 show the life support add-ons which constitute the major weight increases incurred for Flights 5, 7 and 8.

5.6 Significant Mission Problem Areas - Mission feasibility was assessed on the basis of the identified system incompatibilities in terms of performance and the ability to withstand or surpass the expected environments. This mission is thought to be generally feasible when the following type problems have been solved.

5.6.1 Electrical Power -

- a. CSM/AM Interface When Two CSMs are Docked - Flights 1/2/3/4 have only one CSM docked to the cluster at any given period of time. Flights 5/6/7/8 and subsequent flights have two CSMs docked with the cluster for certain time periods of the missions. An additional interface could be required on the cluster that would not be used during Flights 1/2/3/4 but would be required during Flights 5/6/7/8.
- b. Connection of CSM/AM Interface - The connection of power from the AM to the CSM has generally been considered through the CSM ground umbilical when the CSM is docked with the cluster. Studies should be made of how this connection will be made by EVA, how the cables mating with the CSM umbilical will be stored until hooked-up, how the cabling will be supported after hook-up, and how this interface connection can be quickly disconnected in an emergency situation.
- c. Battery Life - The longest known available wet stand time for silver zinc batteries is 90 days. This means the entire life of the batteries is required for a 90 day mission. Studies are necessary to determine the actual requirements and increase the life of silver zinc batteries to a life of possibly 120 days to allow for launch time and possibly extended hold periods during launch.
- d. Battery Temperature Environment - Analysis must be made comparing the required temperature environment of the batteries used in these missions with the expected temperature of the environment the batteries must operate in. If the expected environment temperature range is greater than the required

range of the batteries, environmental control must be provided in the area of the batteries to insure proper operation. Batteries operated in a low temperature environment will result in loss of output and in a high temperature environment will result in deterioration and shortened life. These temperatures must be clearly defined and adhered to.

e. Solar Array Analysis - There is a need for further analysis on the size of the solar array versus the size and number of rechargeable batteries, housekeeping requirements, etc. Analysis should be made on the solar array system to determine shadowing effects of the cluster unique to the particular mission.

5.6.2 Weights - The payload weight statements given in Tables 5.4-1, 5.4-7, 5.4-8 show that Flights 5, 7 and 8 do not have the capability to launch the desired payloads.

5.6.3 System Life From the Standpoint of Reactivation and Resupply.

5.6.4 Meteoroid and Radiation Hazards, Elimination, Detection, and Effect.

5.6.5 Mission Effectiveness with Respect to Crew Usage and Experiment and Operational Performance. (See 5.6.10)

5.6.6 Crew Motion Effects on Pointed Experiments.

5.6.7 The Effect and Prediction of Contamination of Mission Experiments.

5.6.8 The Effect and Prediction of Thermal Distortion (Orbital) on Experiment Performance.

5.6.9 Development of Data Return Requirements Consistent with Spacecraft Capabilities.

5.6.10 Development of Crew Restraints/Work Stations Which Will Assure Adequate Performance With Respect to the Totaled Tasks.

5.6.11 Design and Development of Mounting and Deployment Mechanisms for Mission Systems and Experiments.

5.6.12 Ability of the Crew to Handle the Predicted EVA Requirements.

5.6.13 Assessment and Prediction of a Mission Thermal Profile Which is Consistent With Mission/System Capability When Integrated With Mission Operational and Experiment Requirements.

TABLE 5.4 -1

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

5

AAP FLIGHT NO.

INJECTION CAPABILITY TO INITIAL ORBIT

68900.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU
21946.
3847.
400.
4300.

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

38406.

CONFIGURATION LC5M

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT
3860.
22420.
12357.
843.

PAYLOAD ABOVE 1.0.

39480.

PAYLOAD MARGIN

-1074.

NOTES

220 N. MI. CIRCULAR INCLINATION 28.9 DEGREES
80X220 N. MI. INITIAL ORBIT

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 5.4 -2

AAP FLIGHT NO. 5

SPACECRAFT LCSCM
CARRIER

I	DRY WEIGHT	DESCRIPTION	LCSCM	ADD-ONS	TOTAL
I	DRY WEIGHT	STRUCTURE	9401.	0.	22420.
		STABILIZATION & CONTROL	226.	0.	
		NAVIGATION & GUIDANCE	440.	0.	
		CREW PROVISIONS	84.	354.	
		ENVIRONMENTAL CONTROL	702.	623.	
		DATA MANAGEMENT	480.	0.	
		COMMUNICATION	567.	0.	
		ELECTRIC PWR & DISTR	3181.	0.	
		PROPULSION	1130.	0.	
		RCS	1064.	0.	
		RETROCKETS	1080.	0.	
		SLA RING	90.	0.	
		EARTH LANDING SYSTEM	617.	0.	
		SCIENTIFIC EQUIPMENT	80.	0.	
		GROWTH MSFC	2301.	0.	
		TOTAL DRY WEIGHT	21443.	977.	
		**GROSS DRY WEIGHT			
II	VARIABLE LOAD	MAIN PROPELLANTS	3000.	0.	12357.
		R C PROPELLANTS	2929.	0.	
		CREW PROVISIONS	958.	419.	
		ECS & LIFE SUPT	460.	4153.	
		UNUSABLE SPS	408.	0.	
		TOTAL VARIABLE WEIGHT	7755.	4602.	
		**GROSS VARIABLE LOAD			
III	TOTAL WEIGHT	**GROSS EXPERIMENT WEIGHT			35620.

TABLE 5.4-3
EXPERIMENT LIST - AAP FLIGHT #5

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
x M018	Vectorcardiogram	CM	OWS-1	1	2
x M050	Metabolic Activity	CM	OWS-1	4	4
x M051	Cardiovascular Function	CM	OWS-1	4	4
x M052	Bone and Muscle Changes	CM	OWS-1	19	11
x M053	Human Vestibular Function	CM	OWS-1	23	12
x M054	Neurological Function	CM	OWS-1	6	5
x M055	Time and Motion Study	CM	OWS-1	0	0
x S052	White Light Coronograph	CM	LM/ATM	22	12
x S053A	UV Coronal Spectroheliograph	CM	LM/ATM	20	11
x S053B	UV Spectrographs	CM	LM/ATM	20	11
x S054	X-Ray Spectrograph	CM	LM/ATM	20	11
x S055A	UV Spectrometer	CM	LM/ATM	20	11
x S055B	UV Spectroheliometer	CM	LM/ATM	0	0
x S055C	H α Telescope	CM	LM/ATM	20	11
x S056	X-Ray Telescope	CM	LM/ATM	20	11
x MSFC	H α Telescope	CM	LM/ATM	20	11
x T013	Crew Vehicle Disturbance	CM	OWS-1	11	8
T016	Satellite Obs. of Meteoroid Entry	CM	MDA	6	5
M427	Strap Down Platform	IU	IU	180	34
M441	Acquisition and Tracking Radar	SM	SM	200	36
MSFC-27	Fluid Flowmeter	CM	OWS-1	3	3
x S017	X-Ray Astronomy	--	CSM/LMSS	0	0

NOTES: (a) Added in addition to MSFC Guidelines - Total net weight 621 pounds

Total gross weight 843 pounds

x These experiments will be reactivated from existing OWS-1. Only necessary equipments and consumables needed for reactivation are shown and will be launched.

MARTIN MARIETTA CORPORATION
DENVER DIVISION

TABLE 5.4 -4

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

6

AAP FLIGHT NO.

INJECTION CAPABILITY TO INITIAL ORBIT

59800.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

29306.

CONFIGURATION NONE RACK, IU

SLA
NOSE CAP
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

4100.
1067.
2167.
0.
20538.

PAYLOAD ABOVE 1.U.

27873.

PAYLOAD MARGIN

1433.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 5.4 -5

AAP FLIGHT NO. 6

SPACECRAFT CARRIER	NONE RACK,IU	DESCRIPTION	RACK	ADD-ONS	IU	ADD-ONS	TOTAL
I		DRY WEIGHT					
		STRUCTURE	2000.	0.	0.	0.	
		STABILIZATION, CONTROL	0.	0.	0.	0.	
		NAVIGATION, GUIDANCE	0.	54.	0.	0.	
		CREW PROVISIONS	0.	0.	0.	0.	
		ENVIRONMENTAL CONTROL	0.	0.	0.	0.	
		DATA MANAGEMENT	0.	89.	0.	0.	
		COMMUNICATION	0.	0.	0.	23.	
		ELECTRIC PWR.& DISTR.	0.	0.	0.	0.	
		PURPLUSION	0.	0.	0.	0.	
		REACTION CONTROL SYSTEM	0.	0.	0.	0.	
		SLA RING	0.	0.	0.	0.	
		EARTH LANDING SYSTEM	0.	0.	0.	0.	
		SCIENTIFIC EQUIPMENT	0.	0.	0.	0.	
		GROWTH MSFC	0.	0.	0.	0.	
		TOTAL DRY WEIGHT	2001.	143.	0.	23.	
**GROSS DRY WEIGHT		VARIABLE LOAD					2167.
II		MAIN TANK PROPELLANTS	0.	0.	0.	0.	
		RCS PROPELLANTS	0.	0.	0.	0.	
		CREW PROVISIONS	0.	0.	0.	0.	
		ECS & LIFE SUPT	0.	0.	0.	0.	
		ELECTRICAL POWER	0.	0.	0.	0.	
		TOTAL VARIABLE WEIGHT	0.	0.	0.	0.	
**GROSS VARIABLE LOAD							0.
**GROSS EXPERIMENT WEIGHT							20538.
III		TOTAL WEIGHT				22706.	

TABLE 5.4-6 (Sheet 1)
EXPERIMENT LIST - AAP FLIGHT #6

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
(a) MSFC-53A	EMR-Gamma Ray Line Spectrograph	Rack	Rack (5)	5000	495
(a) MSFC-53B	X-Ray Array	Rack	Rack (5)	3900	386
(a) MSFC-53C	U.V. Stellar Instrument Stabilized Platform	Rack	Rack (5)	925	92
(a) MSFC-53D	Gamma Ray and X-Ray Spectroscopy	Rack	Rack (5)	165	33
(a) MSFC-53E	Digitized Spark Chamber	Rack	Rack (5)	140	30
(a) MSFC-53F	Low Energy Gamma Ray	Rack	Rack (5)	60	20
(a) MSFC-53GI	Impact Studies of Extraterrestrial Dust Particles	Rack	Rack (5)	2	2
(a) MSFC-53GII	Collection Studies of Extraterres- trial Dust Particles	Rack	Rack (5)	2	3
T022	Heat Pipe	IU	IU (6)		
M423	Hydrostatic Gas Bearing	IU	IU (6)	214	37
T017	Meteoroid Impact and Erosion	Rack	Rack (5)	26	13
T021	Meteoroid Velocity	Rack	Rack (7)		
MSFC-28	Leak Detector Demonstration	Rack	External (7)	7	6
MSFC-33	Explosive Metal Cutting	Rack	External (7)	32	14
MSFC-34	Space Bonding	Rack	External (7)	20	11
*** MSFC-47	Multi-Sphere Satellite	POD on S-IVB	External (7)	5000	100
M421	Measurement of Mechanical Properties	Rack	OWS-1	200	36
M422	In-Flight Motor Lubrication	Rack	Rack (7)	200	36
S039	Day/Night Camera	Rack	Rack (8)	180	34
S040	Dielectric Tape Camera	Rack	Rack (8)	98	25

TABLE 5.4-6 (Sheet 2)
EXPERIMENT LIST - AAP FLIGHT #6

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
S041	Millimeter Wave Propagation	Rack	Rack (8)	200	36
S042	Multispectral Photography	Rack	Rack (8)	1044	71
S043	Infrared Temperature Sounding	Rack	Rack (8)	50	18
S044A	O ₂ Microwave Radiometer	Rack	Rack (8)	31	14
S044B	H ₂ O Microwave Radiometer	Rack	Rack (8)	91	25
S045	Near IR Filter Wedge Spectrometer	Rack	Rack (8)	30	14
S046	Polarization Measurements	Rack	Rack (8)	27	13
S047	Measurement of Atmospheric Structure by Star Tracking Tech.	Rack	Rack (8)	132	29
S048	UHF Sferics Detection	Rack	Rack (8)	36	15
S049	High Resolution Infrared Spectroscopy	Rack	Rack (8)	36	15
S050	15 Micron Grating Spectrometer	Rack	Rack (8)	90	24
S060	Multichannel Radiometer	Rack	Rack (8)	18	10
S057	Selective Chopper Radiometer	Rack	Rack (8)	16	10
M484	OWS Artificial G	Rack	OWS-1(8)	260	40
T008	Electrolysis Cell	Rack	Rack	50	18

NOTES: Total Net Weight - 18342 Pounds

Total Gross Weight - 20538 Pounds

(a) Not included in guideline list of experiments for this mission; however, EMR experiments were listed as a NASA Mission objective in an earlier section of the guidelines.

() Number in parenthesis indicates flights on which the experiment is performed.

* Experiments will be reactivated. Equipments and consumables needed for reactivation are shown and will be launched.

*** MSFC 44, 45, 46 and 47 combined.

TABLE 5.4 -7

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 7

	INJECTION CAPABILITY TO INITIAL ORBIT	
SIV-B	21946.	68900.
MARGIN & RESIDUALS	3847.	
MODIFICATIONS	400.	
IU	4300.	
**TOTAL	30493.	PAYLOAD CAPABILITY AT LAUNCH
		38406.

CONFIGURATION LC5M

SLA	3860.
GROSS INERT WEIGHT	22420.
GROSS VARIABLE LOAD	12125.
GROSS EXPERIMENT WEIGHT	541.
PAYLOAD ABOVE I.U.	38947.

PAYLOAD MARGIN

-540.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 26.9 DEGREES
80X220 N. MI. INITIAL ORBIT

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 5.4 -8

AAP FLIGHT NO. 7

SPACECRAFT
CARRIER

LCSM

DESCRIPTION

TOTAL

LCSM ADD-ONS

I DRY WEIGHT

STRUCTURE
STABILIZATION & CONTROL
NAVIGATION & GUIDANCE
CREW PROVISIONS
ENVIRONMENTAL CONTROL
DATA MANAGEMENT
COMMUNICATION
ELECTRIC PWR & DISTR
PROPULSION
RCS
RETROROCKETS
SLA RING
EARTH LANDING SYSTEM
SCIENTIFIC EQUIPMENT
GROWTH MSFC
TOTAL DRY WEIGHT
**GROSS DRY WEIGHT

9401.
226.
440.
84.
702.
480.
567.
3181.
1130.
1064.
1080.
90.
617.
80.
2301.
21443.
977.

II VARIABLE LOAD

22420.

MAIN PROPELLANTS
R C PROPELLANTS
CREW PROVISIONS
ECS & LIFE SUPT
UNUSABLE SPS
TOTAL VARIABLE *EIGHT
**GROSS VARIABLE LOAD
**GROSS EXPERIMENT WEIGHT

3000.
2929.
958.
460.
408.
7755.
4370.

III TOTAL WEIGHT

12125.
541.
35086.

TABLE 5.4-9
EXPERIMENT LIST - AAP FLIGHT #7

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
* M018	Vectorcardiogram	CM	OWS-1	1	2
* M050	Metabolic Activity	CM	OWS-1	4	4
* M051	Cardiovascular Function	CM	OWS-1	4	4
* M052	Bone and Muscle Changes	CM	OWS-1	19	11
* M053	Human Vestibular Function	CM	OWS-1	28	13
* M054	Neurological Function	CM	OWS-1	6	5
* M055	Time and Motion Study	CM	OWS-1	0	0
* S052	White Light Coronagraph	CM	LM/ATM	22	12
* S053A	UV Coronal Spectroheliograph	CM	LM/ATM	20	11
* S053B	UV Coronal Spectrograph	CM	LM/ATM	20	11
* S054	X-Ray Spectrograph	CM	LM/ATM	20	11
* S055A	UV Spectrometer	CM	LM/ATM	20	11
* S055B	UV Spectroheliometer	CM	LM/ATM	0	0
* S055C	H α Telescope	CM	LM/ATM	20	11
* S056	X-Ray Telescope	CM	LM/ATM	20	11
(a) * MSFC	H α Telescope	CM	LM/ATM	20	11
MSFC 16	Optical Guidance System	CM	CM	35	15
S019	UV Stellar Astronomy	CM	CM	95	25
T023	Surface Absorbed Materials	S-IVB-OUT	External	5	4

NOTES: Total Net Weight - 360 Pounds
Total Gross Weight - 541 Pounds

* These experiments will be reactivated from existing OWS-1. Only necessary equipments and consumables needed for reactivation are shown and will be launched.

(a) Added in addition to MSFC Proposal Guidelines

Experiment M402 - Orbital Workshop - Activation and Passivation Procedure, was not considered for AAP Flight #7.

MARTIN MARIETTA CORPORATION
DENVER DIVISION

TABLE 5.4-10

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 8

INJECTION CAPABILITY TO INITIAL ORBIT		68900.
SIV-B		
MARGIN & RESIDUALS	21946.	
MODIFICATIONS	3847.	
IU	400.	
	4300.	
**TOTAL	30493.	
PAYLOAD CAPABILITY AT LAUNCH		38406.

CONFIGURATION LCSCM

SLA	3860.
GROSS INERT WEIGHT	22420.
GROSS VARIABLE LOAD	12125.
GROSS EXPERIMENT WEIGHT	829.
PAYLOAD ABOVE I.U.	39235.

PAYLOAD MARGIN

-828.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 28.9 DEGREES
80X220 N. MI. INITIAL ORBIT

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 5.4-11

AAP FLIGHT NO. 8

SPACECRAFT
CARRIER

LCSM

DESCRIPTION

TOTAL

I DRY WEIGHT

LCSM ADD-ONS

STRUCTURE
STABILIZATION & CONTROL
NAVIGATION & GUIDANCE
CREW PROVISIONS
ENVIRONMENTAL CONTROL
DATA MANAGEMENT
COMMUNICATION
ELECTRIC PWR & DISTR
PROPULSION
RCS
RETROROCKETS
SLA RING
EARTH LANDING SYSTEM
SCIENTIFIC EQUIPMENT
GROWTH MSFC
TOTAL DRY WEIGHT
**GROSS DRY WEIGHT

9401.
226.
440.
84.
702.
480.
567.
3181.
1130.
1064.
1080.
90.
617.
80.
2301.
21443.
977.

II VARIABLE LOAD

22420.

MAIN PROPELLANTS
R C PROPELLANTS
CREW PROVISIONS
ECS & LIFE SUPT
UNUSABLE SPS
TOTAL VARIABLE WEIGHT
**GROSS VARIABLE LOAD
**GROSS EXPERIMENT WEIGHT

3000.
2929.
958.
460.
408.
7755.
0.
0.
419.
3951.
0.
4370.

III TOTAL WEIGHT

12125.
829.
35374.

TABLE 5.4-12
EXPERIMENT LIST - AAP FLIGHT #8

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
* M018	Vectorcardiogram	CM	OWS-1	1	2
* M050	Metabolic Activity	CM	OWS-1	4	4
* M051	Cardiovascular Function	CM	OWS-1	4	4
* M052	Bone and Muscle Changes	CM	OWS-1	19	11
* M053	Human Vestibular Function	CM	OWS-1	23	12
* M054	Neurological Function	CM	OWS-1	6	5
* M055	Time and Motion Study	CM	OWS-1	0	0
* S052	White Light Coronagraph	CM	LM/ATM	22	12
* S053A	UV Coronal Spectroheliograph	CM	LM/ATM	20	11
* S053B	UV Spectrographs	CM	LM/ATM	20	11
* S054	X-Ray Spectrographs	CM	LM/ATM	20	11
* S055A	UV Spectrometer	CM	LM/ATM	20	11
* S055B	UV Spectroheliometer	CM	LM/ATM	0	0
* S055C	H α Telescope	CM	LM/ATM	20	11
* S056	X-Ray Telescope	CM	LM/ATM	20	11
* MSFC	H α Telescope	CM	LM/ATM	20	11
M441	Acquisition and Tracking Radar	SM	SM	200	36
S020	UV X-Ray Solar Astronomy	CM	LM/ATM	10	7
S027	X-Ray Astronomy	IU	IU	164	33
* S017	X-Ray Astronomy	--	IN&SS/MDA	15	9

NOTES: Total Net Weight - 609 Pounds
Total Gross Weight - 829 Pounds

(a) Added in addition to MSFC Proposal Guidelines

* These experiments will be reactivated from existing OWS-1. Only necessary equipments and consumables needed for reactivation are shown and will be launched.

TABLE 1
RECOMMENDED SUBSYSTEM CHANGES

CARRIER IU-5 FLIGHT 5

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (cu)	WEIGHT (lb)
Electrical Pwr	None	No Add-on Pwr Required			
Data Management	None				
Guidance & Cont	None				
Thermal Control	None				
Propulsion	None				
Communications	None				
Display & Cont	None				
Life Support	None				

CARRIER LCSM-5

FLIGHT 5

ED-2002-59
29 March 1967

5-21

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT (lb)
Electrical Pwr	None	Solar Array of AM/ONS/MDA-1 appears adequate			
Data Management	None				
Guidance & Cont	None				
Thermal Control					
Propulsion	Replace		Bladders in RCS tanks	--	Neglig
	Add		RCS Motor Heaters	--	Neglig
	None		SPS Propellant Heaters	--	Neglig
Communications					
Display & Cont	Add	Support T016 Support M441	Panel (CM) Panel (SM) Panel (SM)	5 x 3 x 3 5½ x 4 x 3 7 x 5½ x 10	1 3 2
Life Support	Add	Potable H ₂ O	1 Tank + H ₂ O	12½ OD x 17	73
	Add		3 Nitrogen Tanks + N ₂	26½ OD	905
	Add		2 Cryo O ₂ Tanks + O ₂	41½ ODX 44	3090
	Delete		1 Cryo O ₂ Tank + O ₂	26½ OD	-(402)
	Add	Potable H ₂ O	2 Tanks + H ₂ O	28½ OD x 33	693
	Add		1 Molecular Sieve	12 x 23½ x 35½	93
	Add		1 H ₂ O Reclamation Sys	12 x 23½ x 35½	141
	Add		Food	18 ft ³	495
	Add		Personal Hygiene	11 ft ³	234

TABLE 3-3
RECOMMENDED SUBSYSTEM CHANGES

CARRIER IU-6

FLIGHT 6

ED-2002-59
29 March 1967

5-22

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT (lb)
Electrical Power	None	No Add-on Power Required			
Data Management	Add	To Satisfy Requirements for T022 and M423	1 Auxiliary Storage and Playback 1 Video Switch	20 x 20 x 7 2 x 2 x 4	50 2
Guidance Control	None				
Thermal Control					
Propulsion	None				
Communications	None				
Display & Cont	None				
Life Support	None				

TABLE 4
RECOMMENDED SUBSYSTEM CHANGESCARRIER Rack 6
FLIGHT 5/6/7/8

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT (lb)
Electrical Power	None	No Add-on Power is Required. Solar Array on OWS-1/AM-1 is Assumed Adequate.			
Data Management	Add		1 IM PCM 1 Timing Buffer 1 VCO Package 1 Format Converter 3 Video Recorders 1 Video Switch 1 Video Record Switching/ Control 1 Command Relay Matrix Hardline 1 Horizon Sensor Sys 1 Gyrocompassing Gyro Pkg 1 Control Signal Processing Module 1 Star Tracker Sys	32 x 7 x 5 6 x 4 x 2 8 x 8 x 16 8 x 6 x 3 24 x 10 x 4 2 x 2 x 4 8 x 4 x 4 8 x 4 x 2 7 x 6 x 3 (2) 8 x 6 x 3 8 x 6 1/2 x 2 1/2 6 x 6 x 3 10 x 10 x 4	36 2 14 14 105 2 5 8 10 15 18 36 50
Guidance & Contr	Add	Provide Local Vertical Orientation for EO Experiments			
Thermal Control	None	Provide Accurate Stellar Orientation for EMR			
Propulsion	None				
Communications	None				
Display & Cont	Add	Support D012 D021 D022 M421 M422 M466 M484	Panel(s)	6 x 5 1/2 x 5 1/2 6 x 7 1/2 x 3 1/2 10 1/2 x 6 x 3 1/2 4 x 6 x 3 6 x 13 x 5 8 1/2 x 6 x 5 1/2 3 x 6 x 3	3 4 1/2 6 1/2 1 6 1/2 8 1/2

TABLE 5.5-4 (Continued)
RECOMMENDED SUBSYSTEM CHANGES

CARRIER Rack 6 FLIGHT 6

ED-2002-59
29 March 1967

5-24

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT (lb)
Display & Cont. (Cont.)	Add	Support MSFC - 34	Panel(s)	6 x 3 x 4	2
		MSFC - 44			
		MSFC - 45	TBS		
		MSFC - 46			
		S039	Panel(s)	6½ x 6½ x 4	3
		S040		4½ x 5½ x 6½	2
		S041		6 x 8½ x 6	4½
		S042		4½ x 7 x 4½	2½
		S043		6 x 8 x 3½	3
		S044A & B		4½ x 7½ x 3	2
		S045 and S046		3 x 8½ x 3	2
		S047		5½ x 7 x 5	3
		S048		4½ x 6 x 3	1½
		S049		1½ x 8½ x 3	1
Life Support	None	S050		1½ x 5½ x 3	1
		S060		2 x 6 x 4	2
		S057		2½ x 6 x 3	2
		T017 and T021		3 x 6 x 3	1

TABLE 5-5
RECOMMENDED SUBSYSTEM CHANGES

CARRIER OWS-1/AM-1/MDA-1/LM&SS-1/ FLIGHT 5/6/7/8

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Electrical Power	None	Solar Array of OWS-1/AM-1 Appears Adequate			
Data Management	None				
Guidance & Contr	None				
Thermal Control	None				
Propulsion	None				
Communications	None				
Display & Cont.	None				
Life Support	None				

TABLE 1-6
RECOMMENDED SUBSYSTEM CHANGES

CARRIER IM-ATM-A
FLIGHT 5/6/7/8

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Electrical Power	None	Solar Array on IM/ATM-1 is Assumed to be Adequate			
Data Management	None				
Guidance & Contr	None				
Thermal Control	None				
Propulsion	None				
Communications	None				
Display & Cont.	None				
Life Support	None				

TABLE 5-7
RECOMMENDED SUBSYSTEM CHANGES

CARRIER IU-7 FLIGHT 7

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT(lb)
Electrical Power	None	No Add-on Power Required			
Data Management	None				
Guidance & Contr	None				
Thermal Control	None				
Propulsion	None				
Communications	None				
Display & Contr.	None				
Life Support	None				

RECOMMENDED SUBSYSTEM CHANGES

CARRIER LCSM-7FLIGHT 7ED-2002-59
29 March 1967

5-28

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT (lb)
Electrical Power	None	Supply power from Solar Array on OWS-1/AM-1 Appears Adequate			
Data Management	None				
Guidance & Contr	None				
Thermal Control	None				
Propulsion	Replace		Bladders in RCS Tanks	--	Neglig
	Add		RCS Motor Heaters	--	Neglig
			SPS Propellant Heaters	--	Neglig
Communications	None				
Display & Cont.	Add	Support SOL9	Panel (CM)	2 x 4½ x 3	1½
Life Support	Delete		1 Cryo O ₂ Tank & O ₂	26½ OD	-(400)
			1 H ₂ O Tank + H ₂ O	12½ OD x 17	73
			3 N ₂ Tanks + N ₂	26½ OD	905
			2 Cryo O ₂ Tanks + O ₂	41½ OD x 44	3085
			2 H ₂ O Tanks + H ₂ O	28½ OD x 33	693
			Food	2 ft ³	493
			Personal Hygiene	1 ft ³	234

TABLE 9
RECOMMENDED SUBSYSTEM CHANGES

CARRIER IU-8 FLIGHT 8

ED-2002-59
29 March 1967

5-29

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Electrical Power	None	No Add-on Power is Required			
Data Management	None				
Guidance & Contr	None				
Thermal Control	None				
Propulsion	None				
Communications	None				
Display & Contr.	None				
Life Support	None				

TABLE -10
RECOMMENDED SUBSYSTEM CHANGES

CARRIER LCSM-8 FLIGHT 8

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT (lb)
Electrical Power	None	Power Supply from OWS-1/AM-1 Appears to be Adequate			
Data Management	None				
Guidance & Control	None				
Thermal Control	None				
Propulsion	Replace		Bladders in RCS Tanks	--	Neglig
	Add		RCS Motor Heaters	--	Neglig
			SPS Propellant Heaters	--	Neglig
Communications	None				
Display & Cont.	Add	Support M441	Panel (SM)	2½ x 2 x 3	1.0
		S020	Panel (CM)	3 x 6 x 3½	2.5
Life Support	Same as LCSM-7		Same as LCSM-7	Same as LCSM-7	

TABLE 5.5-11

RCS PROPELLANT ESTIMATE

Vehicle Requirements	5(6) LCSM	7 LCSM	8 LCSM
<u>Experiment Requirements</u>			
Fine Mode Hold	10 ^a	9	21
Coarse Mode Hold	7	23	168
Maneuvers	523	--	--
M484 Art Gravity	--	--	324
<u>Operational Requirements</u>			
Rendezvous and Dock	1480	2220 ^b	740
Dump CMGs	140	140	140
De-Orbit	97	97	97
Total (lbs)	2257	2489	1490

a - Assumes add-ons for EMR

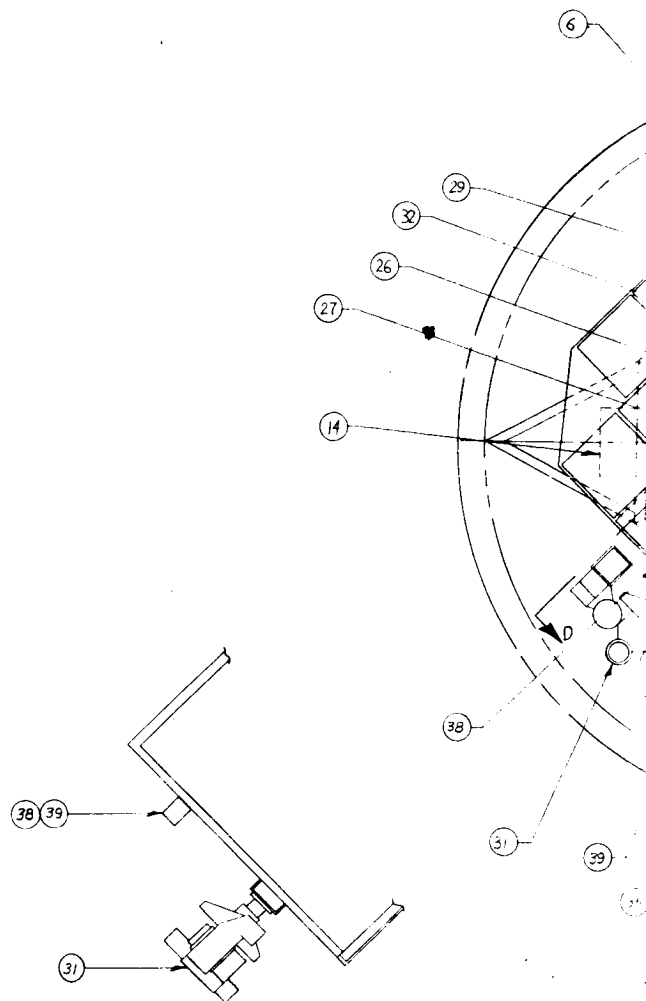
b - Includes 1480 lbs for Pegasus Panel Retrieval

6. MISSIONS 9/10/11/12/13/13A

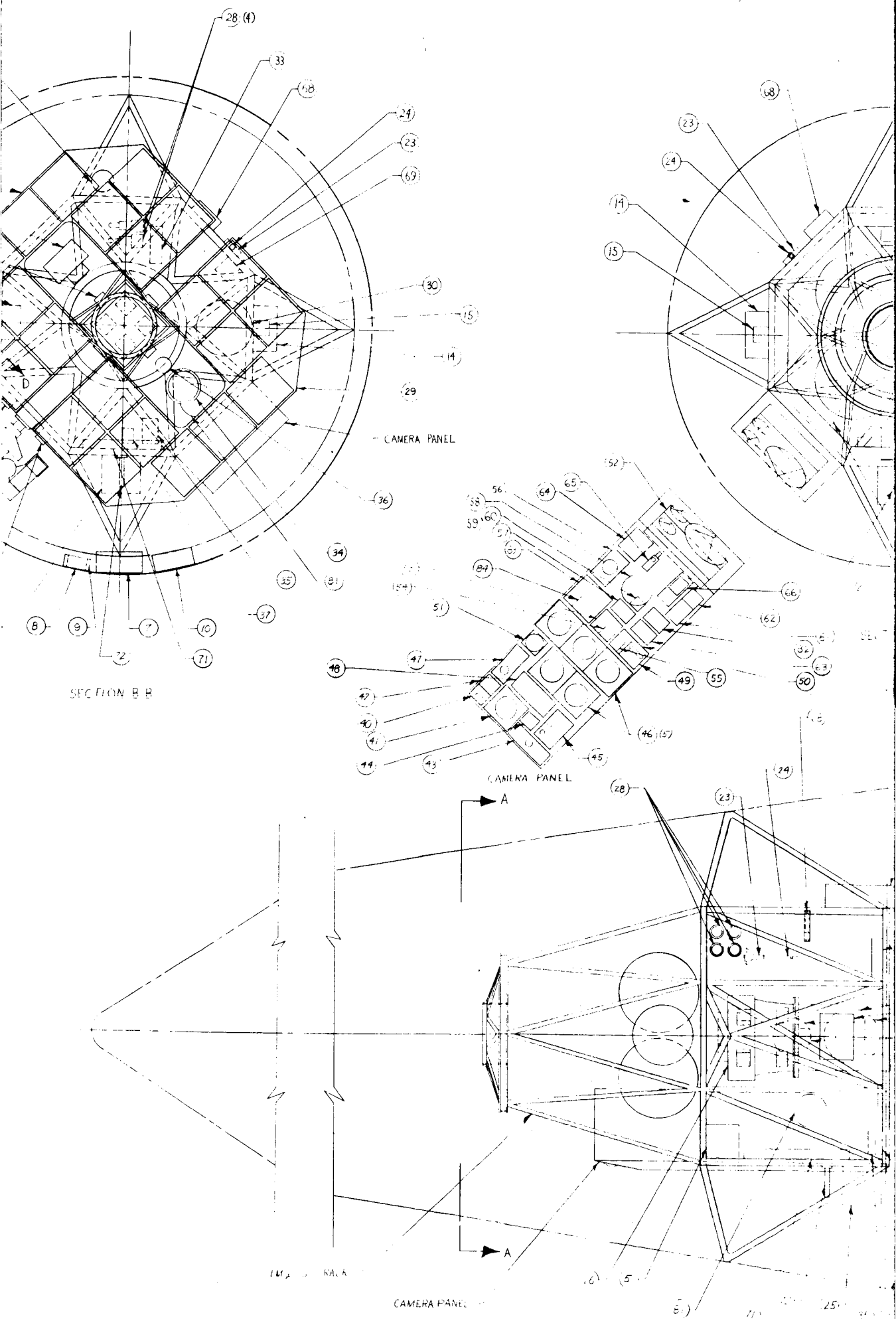
6.1 Mission Plan - This is a low earth orbit (LEO) mission, using AAP flights 9/10/11/12/13/13A. The general mission profile and the mission objectives are given in the General DRMD, Document ED-2001.

6.2 Configuration - The vehicle and payload configurations for the mission are as follows:

Flight 9:	S-IB Stage S-IVB Stage Rack (APP-B) SLA LCSM (Modified)
Flight 10:	S-IB Stage S-IVB Stage AM OWS-2 MDA SLA Nose Cone
Flight 12:	S-IB Stage S-IVB Stage SLA LCSM (90 day)
Flight 11:	S-IB Stage S-IVB Stage Rack/LM/ATM-B SLA Nose Cone
Flight 13:	S-IB Stage S-IVB Stage SLA LCSM (90 day)
Flight (--):	S-IB Stage S-IVB Stage SLA LCSM (90 day)



SECTION D-D



ITEM NO.	EXP NO.	COMPONENT	REPORT NO. ED2002
1			DATE 29 MARCH 67
2		NUMBERS NOT USED	PAGE 5-32
3			
4			
5	M421	MEASUREMENT OF MECHANICAL PROPERTIES	
6	M422	MOTOR GENERATOR SET	
7	M423	HYDROSTATIC GAS BEARING COMPONENTS	
8	M423	MULTIPLEXER	
9	M423	MEASURING DISTRIBUTOR	
10	M423	AUXILIARY STORAGE AND PLAYBACK	
11			
12		NUMBERS NOT USED	
13			
14	M484	BOOM ASSEMBLY	
15	M484	BOOM CONTROL	
16			
17			
18			
19		NUMBERS NOT USED	
20			
21			
22			
23	MSFC-28	LEAK DETECTOR	
24	MSFC-28	LEAK CONTAINER	
25	MSFC-33	EXPLOSION PROOF CABINET	
26	MSFC-34	GAMMA RAY SPECTROMETER	
27	MSFC-34	ELECTRONICS	
28	MSFC-34	REFRIGERATOR (4)	
29	MSFC-34	X-RAY WING PANEL (4)	
30	MSFC-34	GAS STORAGE BOTTLE	
31	MSFC-530	UV STELLAR INSTRUMENT STABILIZED PLATFORM	
32	MSFC-530	GAMMA RAY AND X-RAY SPECTROMETER	
33	MSFC-530	ELECTRONICS	
34	MSFC-530	DIGITIZED SPARK CHAMBER	
35	MSFC-530	ELECTRONICS	
36	MSFC-530	LOW ENERGY GAMMA RAY	
37	MSFC-530	ELECTRONICS	
38	MSFC-530	IMPACT & COLLECTION CYLINDER & CANISTER	
39	MSFC-530	IMPACT & COLLECTION CYLINDER & CANISTER	
40	5039	DAY & NIGHT CAMERA IMAGE ORTHICON	
41	5039	DAY & NIGHT CAMERA - MAPPING CAMERA	
42	5039	DAY & NIGHT CAMERA - ELECTRONICS MODULE	
43	5040	DIELECTRIC TAPE CAMERA	
44	5040	U-BAND TRANSMITTER & ELECTRONICS	
45	5041	MILLIMETER WAVE PROPAGATION - TRANSMITTER ASSY	
46	5042	MULTISPECTRAL PHOTOGRAPHY - MULTIBAND CAMERA (5)	
47	5042	MULTISPECTRAL PHOTOGRAPHY - CALIBRATION CAMERA	
48	5042	ELECTRONICS	
49	5043	INFRARED TEMPERATURE SOUNDING - RADIOMETER HEAD	
50	5043	ELECTRONICS	
51	5044A	O ₂ MICROWAVE RADIOMETER - 5-CHANNEL & ANTENNA	
52	5044B	H ₂ O MICROWAVE RADIOMETER - 5-CHANNEL & ANTENNA	
53	5045	NEAR IR FILTER WEDGE SPECTROMETER	
54	5045	ELECTRONICS	
55	5046	POLARIZATION MEASUREMENTS - SENDING ASSY & ELECTRONICS	
56	5047	MEASUREMENT OF ATMOSPHERIC STRUCTURE - STAR TRACKER	
57	5047	ELECTRONICS	
58	5048	UHF SPHERICS DETECTION - ANTENNA	
59	5048	UHF SPHERICS DETECTION - RECEIVER	
60	5048	UHF SPHERICS DETECTION - SIGNAL PROCESSOR	
61	5049	HIGH RESOLUTION INFRARED SPECTROSCOPY - INTERFEROMETER & TELESCOPE	
62	5049	HIGH RESOLUTION INFRARED SPECTROSCOPY - CALIBRATION BLACKBODY	
63	5050	15 MICRON GRATING SPECTROMETER - OPTICAL HEAD	
64	5050	ELECTRONICS	
65	5051	SELECTIVE CHOPPER RADIOMETER - 2 CHANNEL UNIT	
66	5060	MULTI-CHANNEL RADIOMETER - 3 CHANNEL UNIT	
67	TC08	ELECTROLYSIS CELL	
68	TC07	IMPACT PLATE ASSEMBLY	
69		NUMBER NOT USED	
70		NUMBER NOT USED	
71	TC01	METEOROID VELOCITY IMPACT PLATE	
72	TC02	HEAT PIPE	
73			
74		NUMBERS NOT USED	
75			
76	MSFC-44	SPACE BONDING	
77	MSFC-44	ORBITAL DENSITY MEASUREMENTS	
78	MSFC-44	PHYSICS OF GAS - SURFACE INTERACTION	
79	MSFC-46	ORBITAL DRAG EXPERIMENT	
80	MSFC-47	MULTI SPHERE SATELLITE	
81	5042	MULTISPECTRAL PHOTOGRAPHY - MM TAKE UP	
82	5041	MILLIMETER WAVE PROPAGATION - CRYSTAL REF OSCILLATOR	
83	5044	MICROWAVE RADIOMETER - ANTENNA	
84	5044	MICROWAVE RADIOMETER - RECEIVER	

FIG 52

MARTIN MARIETTA CORPORATION

RESEARCH & DEVELOPMENT

FL-47 "6" MISSILE "AS 213"

DATE 10 MAR 1968

6.3 General Mission Ground Rules

6.3.1 The total mission duration shall be one year. It is accomplished by rendezvous of successive flights and transfer of part of the crew from one CSM to another.

6.3.2 This mission will be planned for the years 1970/1971.

6.3.3 A mission objective is the determination of long duration spaceflight effects on crew members.

6.3.4 A mission objective is to conduct inflight experiments, including solar astronomy, remote earth sensing and bio-lab experiments.

6.3.5 Flight 9 shall be launched three (3) days before Flight 10. The rack, carrying the APP-B experiments shall have a minimum of ninety-three (93) days life.

6.3.6 Flights 9, 12, 13, and 13A shall be manned at launch. Flight 9 utilizes a regular CSM whereas Flights 12, 13, and 13A utilize a 90-day CSM (LCSM modified for re-supply). The 90-day LCSMs will serve as transit and re-supply modules. LCSMs shall have a 7 day transient electric power capability.

6.3.7 Flight 10 will be an unmanned flight carrying the spent S-IVB stage, AM & MDA (OWS-2) into space. The MDA will carry the bio-lab experiments. The OWS-2 shall have an orbital life of a minimum of 360 days. The OWS shall supply all the mission power requirement by solar arrays. The OWS-2 shall carry all of life support commodities to support Flight 9. The only exception will be for the water storage.

6.3.8 Flight 11 payload consists of the LM/ATM-B carrier module, SLA and Nose Cone. The ATM-B experiments will be performed with the carriers undocked from the OWS-2. Rough pointing alignment will be by the LM, fine pointing alignment by the CMGs on the ATM rack. The primary docking mode will be hard with soft tether mode as back-up. LM/ATM-B carrier shall be capable to sustain operation for 180 days minimum (through flights 12 and 13).

6.3.9 The ATM-B experiment package will be integrated on the carrier rack. The integrated package will be made as independent of the carrier as possible to facilitate integration and checkout without dependence upon the carrier package.

6.3.10 The initial orbital cluster consists of the OWS-2, the APP-B experiment carrier and LCSM-9. To this the LM/ATM-B rack is added. The LCSM-9 is utilized to ferry the experiment carriers into the appropriate cluster positions. The LCSM-9 is replaced during the life of the mission with the LCSM-12, -13 and 13A.

6.3.11 The baseline configuration of the LM/ATM-B rack is the LM/ATM-A of Flight 4. Only the difference between the two configurations will be covered herein.

6.3.12 The LCSM from each flight must provide emergency crew quarters and life support provisions during the mission, and accordingly shall be tested and checked out a minimum of every seven days of orbit duration. Thermal control shall be provided to maintain the LCSM propellants (SPS and RCS) in a liquid state.

6.3.13 The life support system shall be two-gas, 5.0 psia, in all carriers (3.5 psia oxygen and 1.5 psia nitrogen).

6.3.14 Project Thermo (M416 through M420, M426) has been shifted from Flight #12 (218) to Flight 27 (223) for better integration into the AAP program. Project Thermo experiments, including rack, weighs approximately 25,000 lbs. and therefore must be boosted by a separate vehicle.

6.3.15 The originally scheduled EMR experiments (MSPC-53A through G) for this flight have been deleted because of excessive payload weight.

6.4 Experiments - The experiments have been assigned to the vehicles in accordance with NASA Proposal Guidelines of 7 March 1967 and are reflected in Tables 6.4-1 through 6.4-18. The tables show the experiments to be performed during each of the six flights and are defined as to launch and performance locations.

6.5 Analysis Result - Recommended subsystem changes and brief justifications for the mission carriers are shown in Tables 6.5-1 through 6.5-10. These tables present the carrier subsystems which require extension of basic capability in order to accomplish the mission objectives and accommodate the NASA list of experiments. The tables also list the weight and size of the suggested add-on. The add-on module selection was based on the use of available flight certified hardware and, wherever possible, Apollo qualified components and subsystems were used.

6.5.1 Electrical Power - The power deficiencies, based on the mission and experiment requirements, were resolved by replacing the SM fuel cells with batteries for the 7 day contingency requirement and using the AM solar array for the operational requirements.

6.5.2 Thermal Control - No changes to the active thermal and environmental control systems have been defined by this analysis. However, some thermal problems are identified in Section 6.6.

6.5.3 Guidance and Control - The Applications "B" experiments require pointing to the local vertical or earth's surface to an accuracy which is beyond the capability of the existing systems. In order to satisfy these pointing requirements, it will be necessary to add a local vertical sensing system (LVS) and a control moment gyro (CMG) control system to the rack. Additionally, a star tracking system was added to the MDA to support an experiment requirement.

6.5.4 Propulsion - It appears to be desirable to remove part of the main propellant tankage based on mission requirement for limited CSM orbital maneuvers. The RCS changes are based on the following requirements for propellants.

<u>FLIGHT</u>	<u>REQ'D (lbs)</u>	<u>CAPABILITY (lbs)</u>	<u>EXCESS OR (DEFICIENT) (lbs)</u>	<u>PAYLOAD</u>
9	2844	1285	(1559)	CSM
10	--	--	--	OWS
12	2330	1285	6	LCSM
11	--	--	--	LM/ATM
13	1717	2336	619	LCSM
13A	1720	2336	616	LCSM

6.5.5 Data Management and Communication - All of the data and communication add-ons are in direct support of the experiment requirements for this mission.

6.5.6 Life Support - Changes in the life support systems are limited to consumables necessary to meet the mission life requirements.

6.5.7 Crew Stations and Controls - Only deficiencies against Flight 10 are defined by this analysis.

ED-2002-59
29 March 1967

APOLLO APPLICATIONS PROGRAM (AAP)
PAYLOAD INTEGRATION

Technical Study and Analysis Report

MISSION FEASIBILITY ANALYSIS, AAP
UNASSIGNED MISSIONS

Contract No. NAS8-21004

CONTENTS

Page 1

	<u>Page</u>
Contents	1
1. INTRODUCTION	1-1
2. CONCLUSIONS.	2-1
3. ANALYSIS APPROACH.	3-1
3.1 Objectives.	3-1
3.2 Method of Analysis.	3-1
3.3 General Ground Rules.	3-2
4. MISSION CARRIERS	4-1
4.1 Description of the Carriers	4-1
5. AAP MISSION 516/7/8.	5-1
5.1 Mission Plan.	5-1
5.2 Configuration	5-1
5.3 Ground Rules.	5-1
5.4 Experiments	5-2
5.5 Analysis Results.	5-2
5.6 Problem Areas	5-4
6. AAP MISSION 9/10/11/12/13/13A.	6-1
6.1 Mission Plan.	6-1
6.2 Configuration	6-1
6.3 Ground Rules.	6-2
6.4 Experiments	6-3
6.5 Analysis Results.	6-3
6.6 Problem Areas	6-5
7. AAP MISSIONS 17/18 and 36.	7-1
7.1 Mission Plan.	7-1
7.2 Configuration	7-1
7.3 Ground Rules.	7-1
7.4 Experiments	7-3
7.5 Analysis Results.	7-3
7.6 Carrier Add-Ons and Problem Areas	7-9
8. MISSIONS 19/20/21/22 or 23/24.	8-1
8.1 Mission Plan.	8-1
8.2 Configuration	8-1

CONTENTS (Continued)

	<u>Page</u>
8.3 Ground Rules	8-1
8.4 Experiments	8-4
8.5 Analysis Results.	8-4
8.6 Problem Areas	8-7
9. AAP MISSION 25/26/27/28/29	9-1
9.1 Mission Plan.	9-1
9.2 Configuration	9-1
9.3 Ground Rules.	9-1
9.4 Experiments	9-4
9.5 Analysis Results.	9-4
9.6 Problem Areas	9-6
10. AAP MISSION 30/31/32/33/34	10-1
10.1 Mission Plan.	10-1
10.2 Configuration	10-1
10.3 Ground Rules.	10-1
10.4 Experiments	10-3
10.5 Analysis Results.	10-4
10.6 Problem Areas	10-5
11. AAP MISSION 523.	11-1
11.1 Mission Plan.	11-1
11.2 Ground Rules.	11-2
11.3 Configuration	11-3
11.4 Carrier Capabilities.	11-3
11.5 Problem Areas	11-3

6.6 Significant Mission Problems - The following performance and environmental problem areas will have to be resolved before mission feasibility can be realized. (Refer also to paragraph 5.6 of this report)

6.6.1 Performance - All mission systems will have to be evaluated for their ability to adequately perform for the planned mission duration when subjected to the mission environments. The following items are representative of the type problems which will be encountered.

6.6.1.1 Electric Power Systems

a. Interfaces between CSM and AM when two CSM's are docked with the cluster - Flights 9/12/13/13A have two CSM's docked with the OWS-2 cluster for certain time periods of the missions. An analysis should be required to determine the effect of this requirement upon Flight 10.

b. Connection of CSM/AM interface - The connection of power from the AM to the CSM has generally been considered through the CSM ground umbilical when the CSM is docked with the cluster. Studies should be made of how this connection will be made by EVA, how the cables mating with the CSM umbilical will be stored until hooked up, how the cabling will be supported after hook-up, and how this interface connection can be quickly disconnected in an emergency situation. Other problems exist in this area, but the above are given as examples. Hook-up of the power interfaces between different carriers at different times have problems unique to the individual missions and all should be analyzed.

c. Solar array system analysis - Major problem areas exist in the solar array system analysis and are as follows:

(1) There is a need to analyze the size of the solar array versus the size and number of rechargeable batteries, housekeeping requirements, etc. In the past, some estimates in calculation are optimistic where others are pessimistic. Is the present array big enough

for an adequate charge rate of the batteries? Is there adequate protection against battery overcharge? Consideration must be made for the batteries on discharge depth, cycle life, charge rates, etc. Consideration must be made for the solar array on pointing requirement contamination.

(2) Analysis should be made on the solar array system to determine shadowing effects of the cluster unique to the particular missions.

6.6.1.2 Propulsion System - Listed below are some design areas requiring further study to extend basic Apollo mission carrier capabilities to 90 days.

a. SPS Propellant Pressurization System - For engine shut-down periods in excess of 21 days it is possible for fuel and/or oxidizer to migrate through the helium check valve assembly and ignite in the helium portion of the propellant feed system or ignite when propellant flow commences.

b. SPS Propellant Gaging - To insure sufficient propellant for a de-orbit maneuver, a zero "g" leak detection and propellant gaging system will have to be developed for the SPS.

c. LM-RCS De-Activation - Provisions should be made to de-activate, or isolate the LM/ATM-B vehicle RCS upon completion of docking with the OWS-2.

6.6.1.3 Crew Station - Analysis of crew activity will have to be made to insure complete data return against all experiment requirements.

6.6.2 Environments

6.6.2.1 Electrical Power Systems

a. Silver zinc battery life for 90-day missions - The longest known available wet stand time for silver zinc batteries is 90 days. This means the

life of the batteries is entirely required for a 90-day mission. Studies are necessary to determine the actual requirements and increase the life of silver zinc batteries to a life of possibly 120 days to allow for launch time and possibly extended hold periods during launch.

b. Thermal control of temperature environment of batteries - Analysis must be made comparing the required temperature environment of the batteries used in these missions with the expected temperature of the environment the batteries must operate in. If the expected environment temperature range is greater than the required range of the batteries, environmental control must be provided in the area of the batteries to insure proper operation. Batteries operated in a low temperature environment will result in loss of output and in a high temperature environment will result in deterioration and shortened life. These temperatures must be clearly defined and adhered to.

6.6.2.2 Propulsion System

a. Teflon Bladders used in CM, SM, and LM reaction control system - Bladder material sensitivity to propellants, temperature and radiation cause degradation of the teflon bladder and helium solution into the propellants during extended periods of exposure. The limit of duration has not been established beyond 14 days and current literature on this subject is unavailable or indeterminate.

b. Engine Heaters Used in SM-RCS, and SPS systems - Existing engine heaters do not prevent propellant freeze-up whenever shading of the engine occurs for periods of three to four hours and longer.

6.6.2.3 Crew stations additional analyses are required to develop crew safe areas and adequate hazardous warning for adverse environmental conditions including:

- a. Sudden decompression
- b. Fire
- c. Toxic atmosphere
- d. Temperature
- e. Radiation
- f. Pressure

6.6.3 Weights - The payload weight statements given in Tables 6.4-1, 6.4-10, 6.4-13, 6.4-16 show that Flights 9, 12, 13, and 13A do not have the capability to launch the desired payloads.

TABLE 6.4 -1

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

9

AAP FLIGHT NO.

INJECTION CAPABILITY TO INITIAL ORBIT 68200.

SIV-B
MARGIN & RESIDUALS 21946.
MODIFICATIONS 3847.
IU 400.
4300.

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

37706.

CONFIGURATION LC5M RACK

SLA
GROSS INERT WEIGHT 3860.
GROSS VARIABLE LOAD 24486.
GROSS EXPERIMENT WEIGHT 9057.
4589.

PAYLOAD ABOVE 1.U.

41992.

PAYLOAD MARGIN

-4286.

NOTES

80 X 260 N. MI. INITIAL ORBIT
TRANSFER TO
260 N. MI. CIRCULAR ORBIT INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 6.4 -2

AAP FLIGHT NO. 9

SPACECRAFT
CARRIER

LCSCM
RACK

DESCRIPTION

TOTAL

ADD-ONS

RACK

ADD-ONS

LCSCM

I

DRY WEIGHT

STRUCTURE
STABILIZATION & CONTROL
NAVIGATION & GUIDANCE
CREW PROVISIONS
ENVIRONMENTAL CONTROL
DATA MANAGEMENT
COMMUNICATION
ELECTRIC PWR & DISTR
PROPULSION
RCS

REINFORCEMENTS

SLA RING
EARTH LANDING SYSTEM
SCIENTIFIC EQUIPMENT
GROWTH MSFC

TOTAL DRY WEIGHT

**GROSS DRY WEIGHT

II

VARIABLE LOAD

MAIN PROPELLANTS

R C PROPELLANTS

CREW PROVISIONS

ECS & LIFE SUPT

UNUSABLE SPS

TOTAL VARIABLE WEIGHT

**GROSS VARIABLE LOAD

**GROSS EXPERIMENT WEIGHT

III

TOTAL WEIGHT

9401.	0.	2000.	0.	0.	24486.
226.	0.	0.	799.	0.	
440.	0.	0.	0.	0.	
84.	0.	0.	0.	0.	
702.	151.	0.	93.	0.	
480.	0.	0.	0.	0.	
567.	0.	0.	0.	0.	
3181.	0.	0.	0.	0.	
1130.	0.	0.	0.	0.	
1064.	0.	0.	0.	0.	
1080.	0.	0.	0.	0.	
90.	0.	0.	0.	0.	
617.	0.	0.	0.	0.	
80.	0.	0.	0.	0.	
2301.	0.	0.	0.	0.	
21443.	151.	2000.	892.	0.	
3000.	0.	0.	0.	0.	
2929.	0.	0.	0.	0.	
958.	0.	0.	0.	0.	
460.	1302.	0.	0.	0.	
408.	0.	0.	0.	0.	
7755.	1302.	0.	0.	0.	
					9057.
					4589.
					38132.

TABLE 6.4-3
EXPERIMENT LIST FOR FLIGHT #9

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
	Application "B"				
	Scanning UV Visible and IR Absorption Spect.	Rack	Rack	30	14
	UV Imager Spectrometer	Rack	Rack	150	31
	Synoptic Multiband	Rack	Rack	1400	139
	Metric Camera	Rack	Rack	300	43
	Hi Resolution Panoramic Camera Systems	Rack	Rack	600	57
	Multispectral Tracking Telescope	Rack	Rack	861	85
	Passive Microwave Imager	Rack	Rack	185	34
	Broad Band Spectral Scanner	Rack	Rack	30	14
	Laser Altimeter	Rack	Rack	75	22
	UV Remote Sensing Measurements	Rack	Rack	100	26
	Infrared Spectrometer Radiometer	Rack	Rack	60	20
	Cosmic Ray Neutron Albedo Measurements	Rack	Rack	10	7
T009	Primates in Long Term Zero G	SM	Deploy into Space	250	39

NOTES: Total net weight - 4051 pounds.
Total gross weight - 4589 pounds

TABLE 6.4 -4

PAYLOAD WEIGHT STATEMENT (POUNDS) AAP FLIGHT NO. 10

INJECTION CAPABILITY TO INITIAL ORBIT 56400.

SIV-B
MARGIN & RESIDUALS

IU
21946.
3847.
0.
4300.

**TOTAL 30093. PAYLOAD CAPABILITY AT LAUNCH 26306.

CONFIGURATION NONE OWS MDA AM

SLA 4100.
NOSE CAP 1067.
GROSS INERT WEIGHT 20178.
GROSS VARIABLE LOAD 219.
GROSS EXPERIMENT WEIGHT 463.

PAYLOAD ABOVE 1.U. 26029.

PAYLOAD MARGIN

277.

NOTES

260 N. MI. CIRCULAR ORBIT INCLINATION 28.9 DEGREES
ORBITAL WORKSHOP MODIFICATIONS IN GROSS
WEIGHT INCLUDE STANDARD SIV-B MODIFICATIONS

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 6.4 -5

AAP FLIGHT NO. 10

SPACECRAFT CARRIER	DESCRIPTION	OWS	ADD-ONS	MDA	ADD-ONS	AM	ADD-UNS	TOTAL
I	DRY WEIGHT							
	STRUCTURE	1139.	0.	2566.	0.	2484.	100.	
	NAVIGATION, GUIDANCE	0.	0.	0.	0.	0.	0.	
	STABILIZATION, CONTROL	0.	0.	0.	0.	0.	0.	
	CREW PROVISIONS	843.	0.	361.	50.	0.	0.	
	ENVIRONMENTAL CONTROL	402.	0.	449.	0.	612.	120.	
	DATA MANAGEMENT	0.	0.	0.	0.	0.	104.	
	COMMUNICATION	0.	0.	0.	0.	202.	47.	
	ELECTRIC PWR. & DISTR.	0.	0.	0.	0.	200.	1812.	
	PROPULSION	0.	0.	0.	0.	0.	0.	
	REACTION CONTROL SYSTEM	0.	0.	0.	0.	0.	0.	
	SLA RING	0.	0.	0.	0.	0.	0.	
	EARTH LANDING SYSTEM	0.	0.	0.	0.	0.	0.	
	CRYOGENIC SUPPLY SYSTEM	0.	0.	0.	0.	3898.	0.	
	GFE	0.	0.	0.	0.	500.	0.	
	SOLAR ELECTRIC SYSTEM	0.	0.	0.	0.	0.	4100.	
	AM/S-IVB FURNISHINGS	0.	0.	0.	0.	189.	0.	
	TOTAL DRY WEIGHT	2384.	0.	3376.	50.	8085.	6283.	20178.
	**GROSS DRY WEIGHT							
II	VARIABLE LOAD							
	MAIN TANK PROPELLANTS	0.	0.	0.	0.	0.	0.	
	RCS PROPELLANTS	0.	0.	0.	0.	0.	0.	
	CREW PROV. & LIFE SPT.	0.	0.	219.	0.	0.	0.	
	TOTAL VARIABLE WEIGHT	0.	0.	219.	0.	0.	0.	219.
	**GROSS VARIABLE LOAD							463.
	**GROSS EXPERIMENT WEIGHT							
III	TOTAL WEIGHT							20861.

TABLE 6.4-6
EXPERIMENT LIST - AAP FLIGHT #10

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
T005	Biomedical Lab (Early Version)	MDA	OWS-2	12	8
T007	Fusible Material Radiator	MDA	OWS-2	35	15
T014	Human Transfer Function	MDA	OWS-2	10	7
	Orbital Horizon Definition	MDA	MDA	80	23
MSFC-26(M429A)	Liquid Drop Dynamics	MDA	OWS-2	95	25
MSFC-43(M329B)	Fluid Density Gradient	MDA	OWS-2	42	17
MSFC-54	Behavior of Particulate Material	MDA	OWS-2	70	22
	Project Thermo	See Note *			
M426	Condensing Heat Transfer	See Note *			
MSFC-47	Multisphere Satellite	See Note **			

NOTES: Total net weight - 344 pounds
Total gross weight - 463 pounds

* These experiments cannot be accommodated on this mission because of weight and have been dropped for purposes of this study. However, these experiments are included in Flight 27.

** This experiment was eliminated from this mission because of weight and size, but it is included on Flight 6.

TABLE 6.4 -7

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 11

INJECTION CAPABILITY TO INITIAL ORBIT 56400.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

21946.
3847.
400.
4300.

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

25906.

CONFIGURATION NONE LM/ATH-B

SLA
NOSE CAP
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

4100.
1067.
17618.
1090.
1779.

PAYLOAD ABOVE I.U.

25655.

PAYLOAD MARGIN

251.

NOTES

260 N. MI. CIRCULAR ORBIT INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 6.4 -8

AAP FLIGHT NO. 11

SPACECRAFT NONE
CARRIER LM/ATM-B

DESCRIPTION	LEM	ADD-ONS	ATM	ADD-ONS	TOTAL
I					
DRY WEIGHT					
STRUCTURE	1326.	0.	2250.	688.	
STABILIZATION, CONTROL	87.	0.	0.	0.	
NAVIGATION, GUIDANCE	289.	0.	0.	1548.	
CREW PROVISIONS	103.	44.	0.	0.	
ENVIRONMENTAL CONTROL	347.	0.	0.	225.	
DATA MANAGEMENT	350.	0.	0.	306.	
COMMUNICATION	100.	0.	0.	1396.	
ELECTRIC PWR. & DISTR.	213.	0.	0.	2281.	
PROPULSION	15.	0.	0.	0.	
REACTION CONTROL SYSTEM	386.	0.	0.	0.	
SOLAR PANELS	0.	0.	0.	5150.	
SCIENTIFIC EQUIPMENT	0.	0.	0.	0.	
GROWTH MSFC	514.	0.	0.	0.	
TOTAL DRY WEIGHT	3730.	44.	2250.	11594.	17618.
**GROSS DRY WEIGHT					
VARIABLE LOAD					
MAIN TANK PROPELLANTS	0.	0.	0.	0.	
RCS PROPELLANTS	608.	0.	0.	0.	
CREW PROVISIONS	0.	106.	0.	107.	
ECS & LIFE SUPT	0.	0.	269.	0.	
TOTAL VARIABLE WEIGHT	608.	106.	269.	107.	1090.
**GROSS VARIABLE LOAD					1779.
**GROSS EXPERIMENT WEIGHT				20487.	
TOTAL WEIGHT					
II					
III					

TABLE 6.4-9
EXPERIMENT LIST - AAP FLIGHT #11

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
S052	<u>ATM</u> White Light Coronagraphy	LM/ATM	LM/ATM	106	26
S053A	UV Coronal Spectrograph	LM/ATM	LM/ATM	260	40
S053B				260	40
S054	X-Ray Spectrographic Telescope	LM/ATM	LM/ATM	168	33
S055A	UV Spectrometer	LM/ATM	LM/ATM	120	28
S055B	UV Spectrometer	LM/ATM	LM/ATM	110	27
S055C	H α Telescope	LM/ATM	LM/ATM	130	29
S056	X-Ray Telescope	LM/ATM	LM/ATM	260	40
(a) MSFC	H α Telescope	LM/ATM	LM/ATM	75	22

NOTES: Total net weight ~ 1489 pounds
Total gross weight ~ 1779 pounds

(a) Added in addition to NASA Proposal Guidelines of 7 March 1967.

TABLE 6.4-10

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

12

AAP FLIGHT NO.

INJECTION CAPABILITY TO INITIAL ORBIT

68200.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

21946.
3847.
400.
4300.

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

37706.

CONFIGURATION LCSCM

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
22420.
12125.
395.

PAYLOAD ABOVE 1.U.

38800.

PAYLOAD MARGIN

-1094.

NOTES

80 X 260 N. MI. INITIAL ORBIT
TRANSFER TO
260 N. MI. CIRCULAR ORBIT INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 6.4-11

AAP FLIGHT NO. 12

SPACECRAFT
CARRIER

LCSM

DESCRIPTION

LCSM

ADD-ONS

TOTAL

I DRY WEIGHT

STRUCTURE
STABILIZATION & CONTROL
NAVIGATION & GUIDANCE
CREW PROVISIONS
ENVIRONMENTAL CONTROL
DATA MANAGEMENT
COMMUNICATION
ELECTRIC PWR & DISTR
PROPULSION
RCS
RETROROCKETS
SLA RING
EARTH LANDING SYSTEM
SCIENTIFIC EQUIPMENT
GROWTH MSFC
TOTAL DRY WEIGHT
**GROSS DRY WEIGHT

9401.
226.
440.
84.
702.
480.
567.
3181.
1130.
1064.
1080.
90.
617.
80.
2301.
21443.
977.

II VARIABLE LOAD

MAIN PROPELLANTS
R C PROPELLANTS
CREW PROVISIONS
ECS & LIFE SUPT
UNUSABLE SPS
TOTAL VARIABLE WEIGHT
**GROSS VARIABLE LOAD
**GROSS EXPERIMENT WEIGHT

3000.
2929.
958.
460.
408.
7755.
0.
0.
419.
3951.
0.
4370.

22420.

III TOTAL WEIGHT

12125.
395.
34940.

TABLE 6.4-12
EXPERIMENT LIST - AAP FLIGHT #12

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
--	Earth Albedo Measurements	CM	CM	50	18
(a) M430	LEM Relay Experiment	CM	CM	187	35
--	ATM 28 Day Performance	--	LM/ATM	81	23
(b) --	EMR	(See Note B)			

NOTES: Total net weight - 318 pounds
Total gross weight - 395 pounds

- (a) Added in addition to NASA Proposal Guidelines, 7 March 1967, because it is a prerequisite for M430 on Flight 19 (CSM portion of LEM Relay Experiment only)
- (b) The EMR experiments have been eliminated from this mission because of weight limitations.

TABLE 6.4-13

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 13

INJECTION CAPABILITY TO INITIAL ORBIT 68900.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

38406.

CONFIGURATION LC5M

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
22420.
12125.
394.

PAYLOAD ABOVE I.U.

38800.

PAYLOAD MARGIN

-393.

NOTES

80X220 N. MI. ORBIT TO 220 N. MI. CIRCULAR ORBIT
INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 6.4-14

AAP FLIGHT NO. 13

SPACECRAFT LCSCM
CARRIER

	DESCRIPTION	LCSCM	ADD-ONS	TOTAL
I	DRY WEIGHT			
	STRUCTURE	9401.	0.	
	STABILIZATION & CONTROL	226.	0.	
	NAVIGATION & GUIDANCE	440.	0.	
	CREW PROVISIONS	84.	354.	
	ENVIRONMENTAL CONTROL	702.	623.	
	DATA MANAGEMENT	480.	0.	
	COMMUNICATION	567.	0.	
	ELECTRIC PWR & DISTR	3181.	0.	
	PROPULSION	1130.	0.	
	RCS	1064.	0.	
	RETROCKETS	1080.	0.	
	SLA RING	90.	0.	
	EARTH LANDING SYSTEM	617.	0.	
	SCIENTIFIC EQUIPMENT	80.	0.	
	GROWTH MSFC	2301.	0.	
	TOTAL DRY WEIGHT	21443.	977.	
	**GROSS DRY WEIGHT			22420.
II	VARIABLE LOAD			
	MAIN PROPELLANTS	3000.	0.	
	R C PROPELLANTS	2929.	0.	
	CREW PROVISIONS	958.	419.	
	ECS & LIFE SUPT	460.	3951.	
	UNUSABLE SPS	408.	0.	
	TOTAL VARIABLE WEIGHT	7755.	4370.	
	**GROSS VARIABLE LOAD			12125.
	**GROSS EXPERIMENT WEIGHT			394.
III	TOTAL WEIGHT			34939.

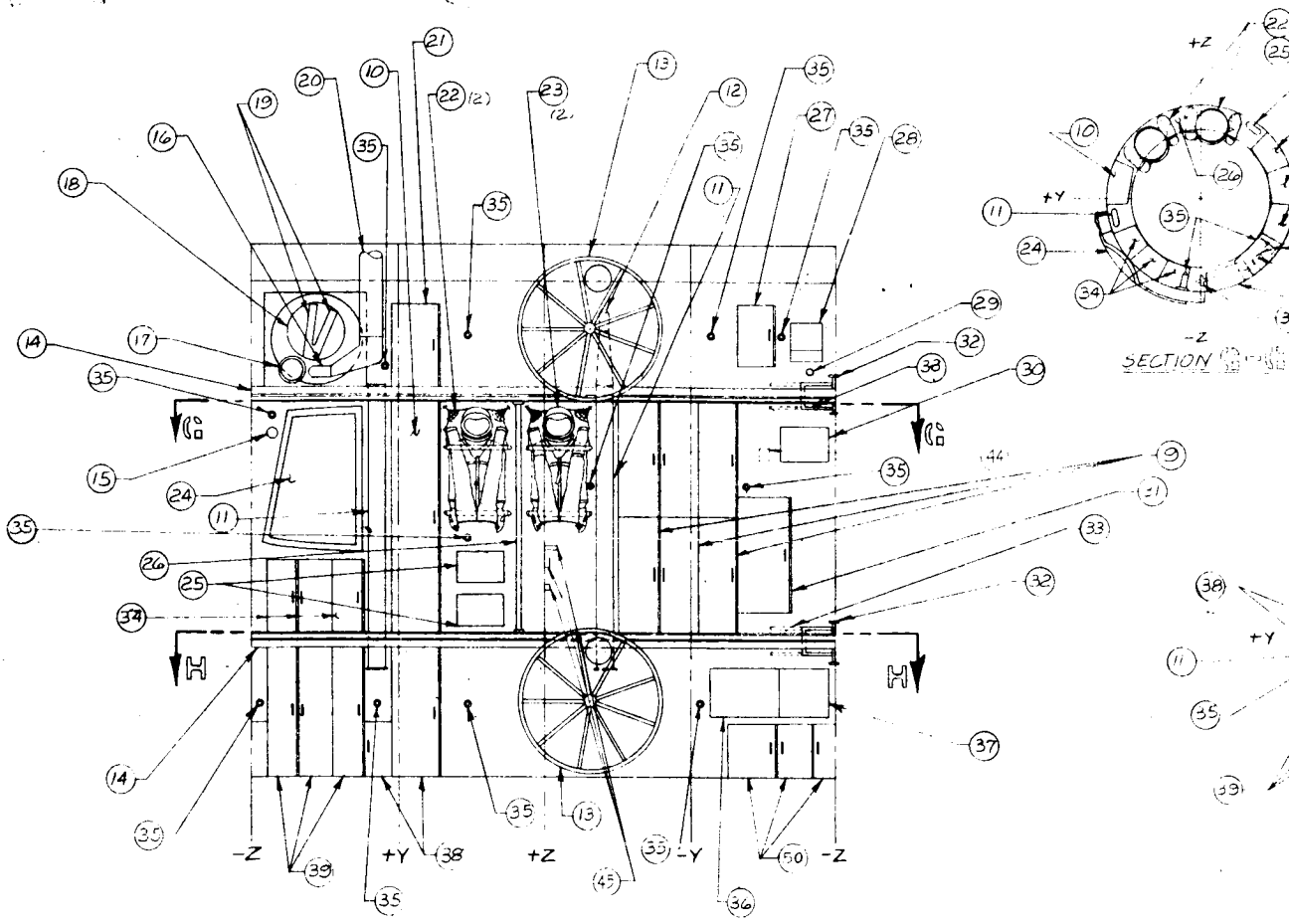
ED-2002-59
29 March 1967

6-23

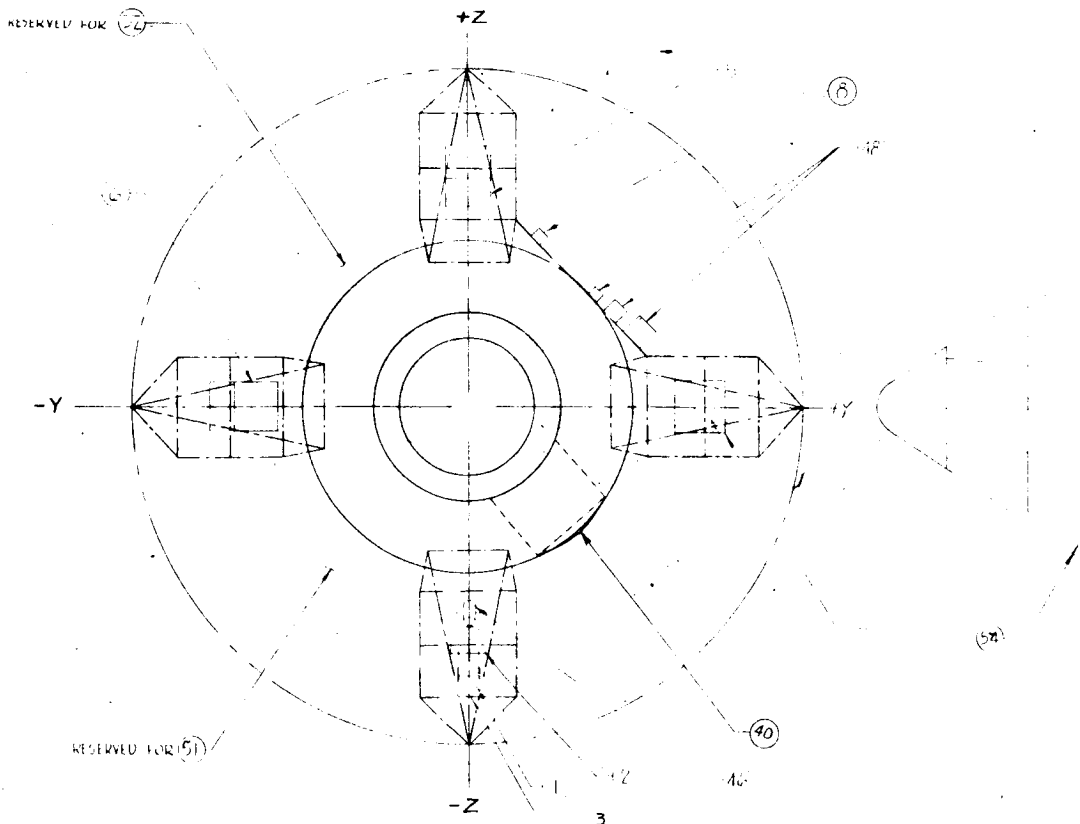
TABLE 6.4-15
EXPERIMENT LIST - AAP FLIGHT #13

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
--	ATM 28 Day Performance (Resupply)	CSM	LM/ATM	250	39
T009	Primates in Long Term Zero G		Ext.	81	23

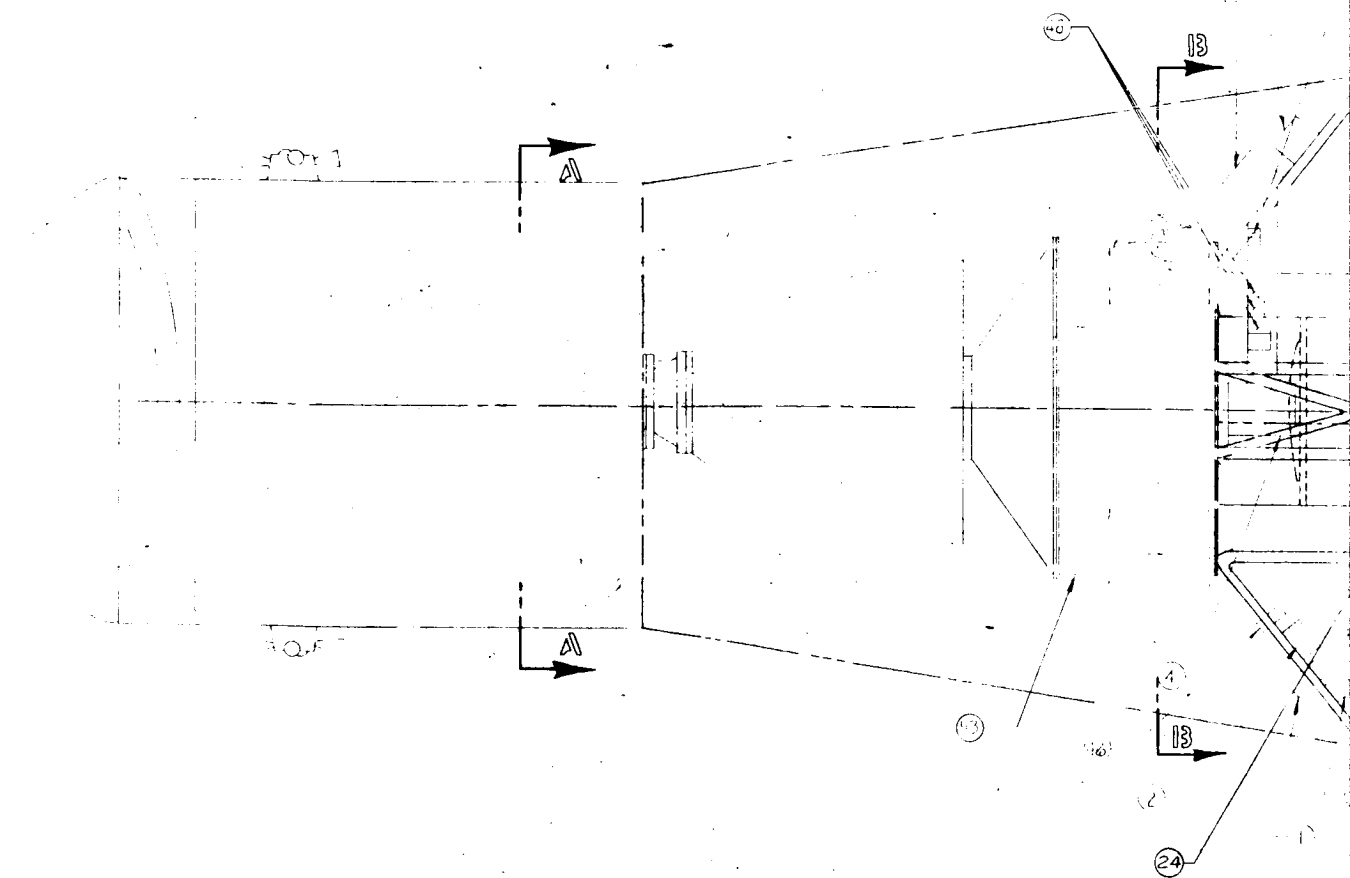
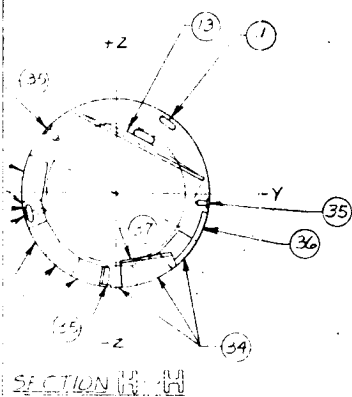
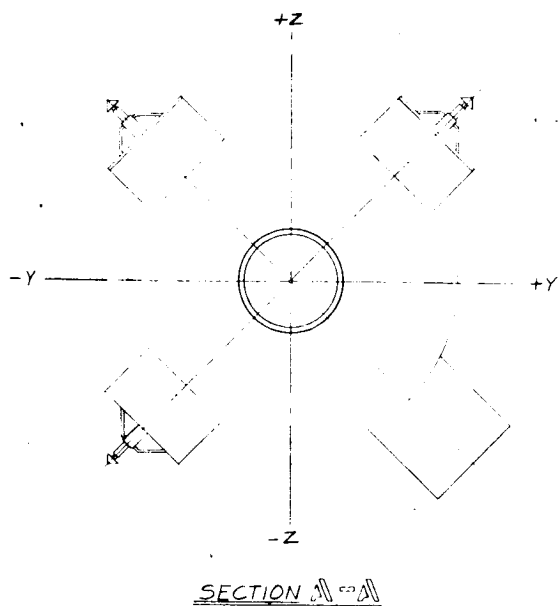
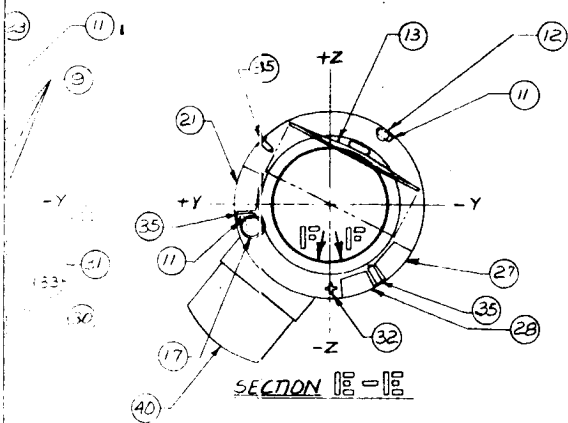
NOTES: Total net weight - 331 pounds
Total gross weight - 394 pounds

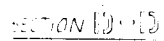


VIEW 13-13 AM TUNNEL INTERIOR STRETCH OUT
 FOR COMPONENTS ON AM OUTSIDE OF
 TUNNEL SEE DRAWING OF AM IN MCCONNELL
 REPORT NO E539

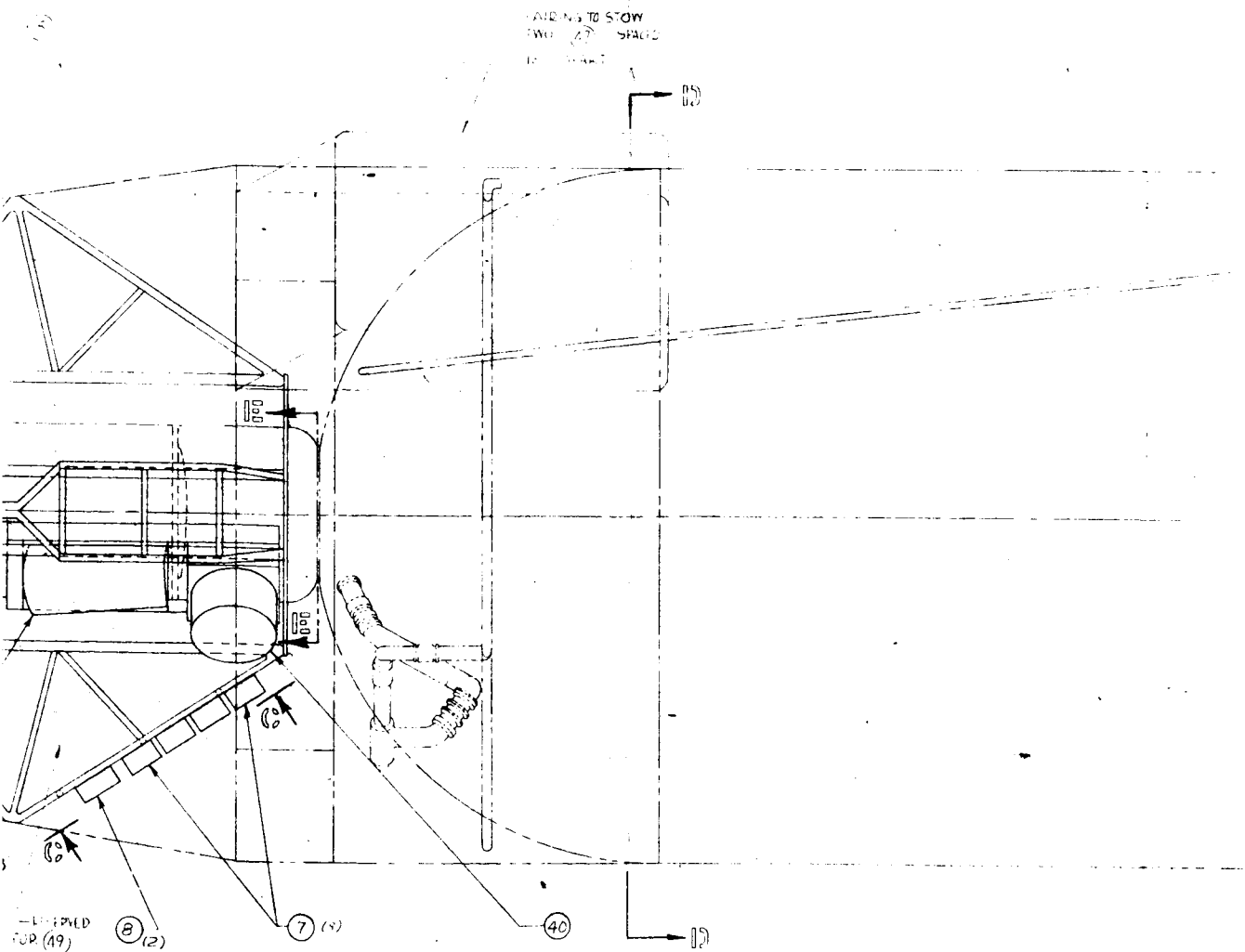


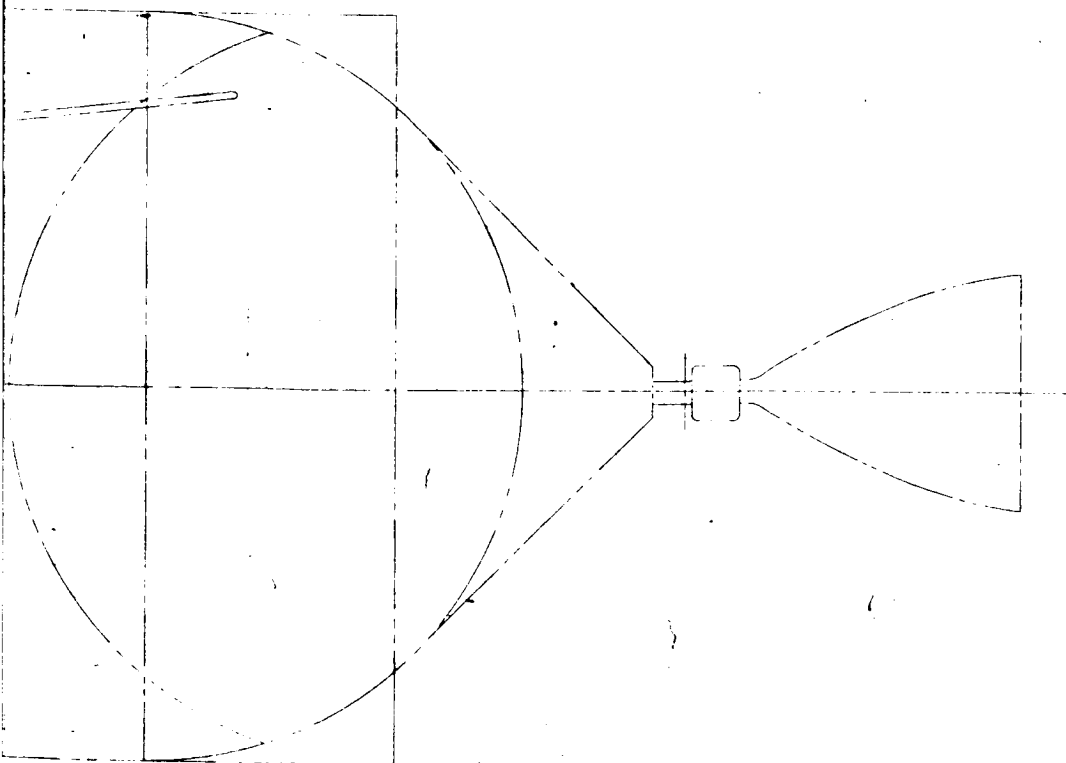
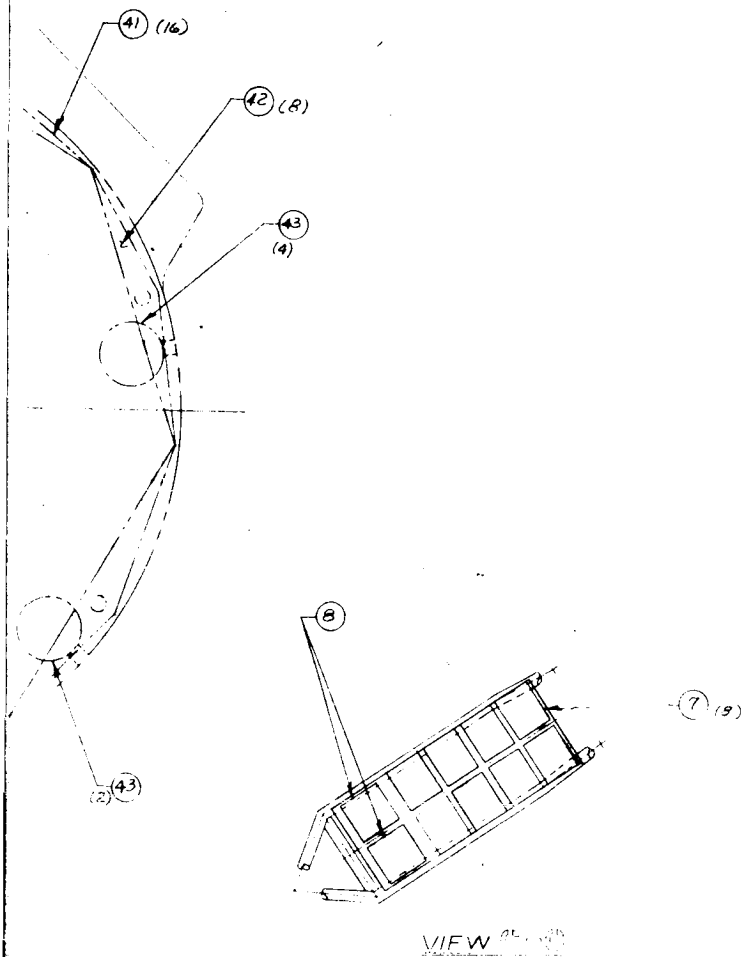
SECTION 13-13





PAIRING TO STOW
TWO (2) SPACES
IN FRONT





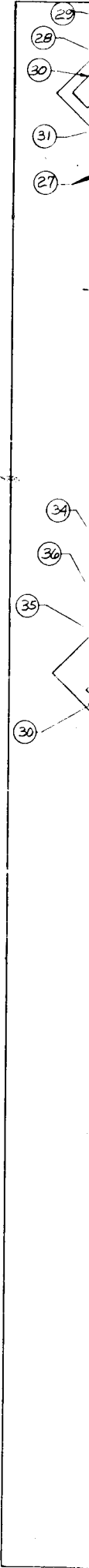
ITEM NO	EXP NO	COMPONENT	REPORT ED2002-59 DATE 29 MARCH 1967 PAGE 6-23
1	5039	CAMERA HEAD (DAY NIGHT CAMERA)	
2	5039	TAPE RECORDER	
3	5039	CAMERA ELECTRONICS MODULE	
4	5039	MERKIS CAMERA	
5	5039	HIGH & COSMIC RAY	
6	5022	LOW & COSMIC RAY	
7	5039	BATTERY PACKAGE (d)	
8	5039	INVERTER (2), DISTRIB. SYSTEM	
9		DATA MANAGEMENT - CONSISTS OF THE FOLLOWING: PROGRAMMER, VIDEO SWITCH, VIDEO RECORDER HIGH LEVEL MULTIPLEXER LOW LEVEL MULTIPLEXER TAPE RECORDER ELECTRONIC TIMER RELAY PACKAGE DIGITAL RECORDER SIGNAL CONDITIONER D.C. CONVERTER	
10		EVA UMBILICAL & 10' TRANSITION UMBILICAL STORAGE	
11		VENTILATION DUCT (2)	
12		FAN ASSY	
13		AIRLOCK HATCH (STOWED)	
14		DEBRIS GUARD (2)	
15		EQUALIZATION VALVE	
16		TUNNEL VENT VALVE	
17		TANK	
18		ECS CANISTER	
19		SOLIDS TRAP INLET & COMPRESSOR	
20		POLYETHYLENE DUCT	
21		SIB LIGHT ASSY (PORTABLE) & EXTENSION STORAGE	
22		NET HELMET RETAINER (2)	
23		ASTRONAUT SUIT STORAGE (2)	
24		EMERGENCY HATCH	
25		CHEST PACK (2)	
26		HAND PAIL	
27		UTILITY LIGHT & 1 FT COTED WIRE BUNDLE	
28		AFT INST PANEL	
29		OXYGEN VENT	
30		CENTER INST PANEL AIRLOCK CONTROL	
31		HAIRY SUPPLY BOTTLE MARK TOOL & REPAIR KIT STORAGE	
32		AIRLOCK PRESSURIZATION VALVE (2)	
33		WHEEL & GEARBOX ASSY	
34		ENTER STORAGE SINK (2)	
35		LIGHT ASSY (12)	
36		FWD INST PANEL	
37		INST PANEL	
38		CAMERA EQUIPMENT STORAGE	
39		FOOD PERSONAL HYGIENE & WASTE MANAGEMENT HARDWARE STORAGE	
40		EGG PACKAGE COVER	
41		THERMAL CONTROL SLEEVE (16)	
42		HELIUM COVER (8)	
43		HELIUM SPHERE (6)	
44		RADIATION MEASUREMENT	
45		OWS HABITABILITY KIT	
46		CHARGED PARTICLE SPECTROMETER	
47	SYS ADD ON	SOLAR ARRAY (400W)	
48	SYS ADD ON	LOCAL VERTICAL SYSTEM	
		GYROCOMPASSING PACKAGE	
		CONTROL SIGNAL PROCESSING MODULE	
49	SYS ADD ON	O ₂ SUPPLY	
50	SYS ADD ON	PLUS BATTERIES, PLUS LION	
51		EARTH ALBEDO MEASUREMENT	
52		THERMAL CONTROL SURFACES	
53		ALL ITEMS LISTED BELOW ARE LOCATED IN THE MDA - DISPLAY & CONTROL FOR 5022 & 5023 - CONTROL PANELS FOR 5022 & 5023 - (1) RADIATION MEASUREMENT (STOWED FOR OWS) 4 1/4 X 4 1/4 X 10 - (1) HARD MTD RADIATION MEASUREMENT 3 1/4 X 4 X 4 1/4 - (2) RADIATION MEASUREMENT (STOWED FOR OWS) 3 1/4 X 4 X 4 1/4 - OWS HABITABILITY KIT (FOR OWS)	
54		ALL ITEMS LISTED BELOW ARE LOCATED IN THE CM - (1) RADIATION MEASUREMENT 4 1/4 X 4 1/4 X 10 - SIGNAL CONDITIONER READOUT FOR RADIATION MEASUREMENT - (1) OWS HABITABILITY KIT - NAVIGATION PHOTOGRAPHY - MEASUREMENT OF ZODIACAL LIGHT FROM EARTH ORBIT - LIBRATION REGION PHOTOGRAPHY - EISENSTEIN & ZODIACAL LIGHTS - LEM RELAY	

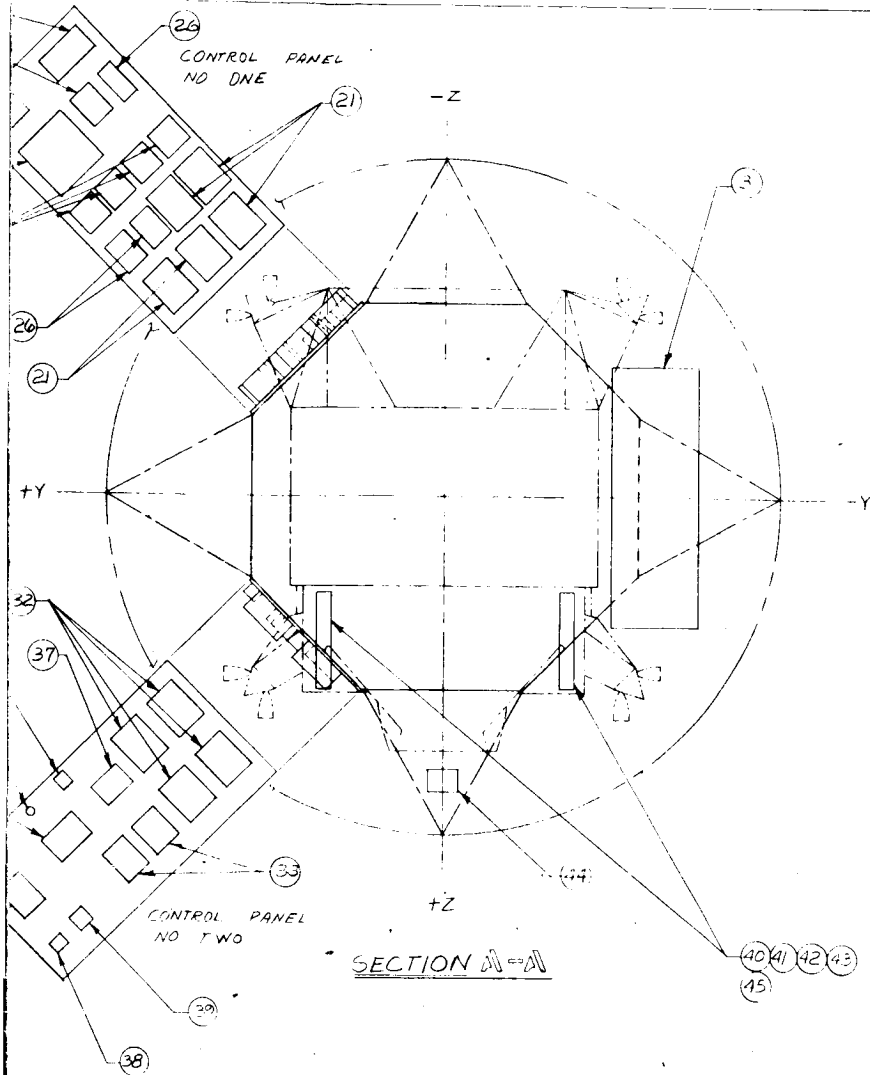
NOTES:

PRELAUNCH NEW QUARTER CONDITIONS IN THE SIB TO BE SUPPLIED.

FIG 73.1

MARTIN COMPANY A DIVISION OF MARTIN MARIETTA CORPORATION <small>PERMANENT INDUSTRIAL FACILITY, BETHLEHEM, PA.</small>	
GENERAL CONFIGURATION MDA / AM / SIB FLIGHT 11 MISSION 513	
38597	AAP-1083
1/20	107





(14) -
(4)

(15) -
(DEPLOYED)

(10) -

(16) -

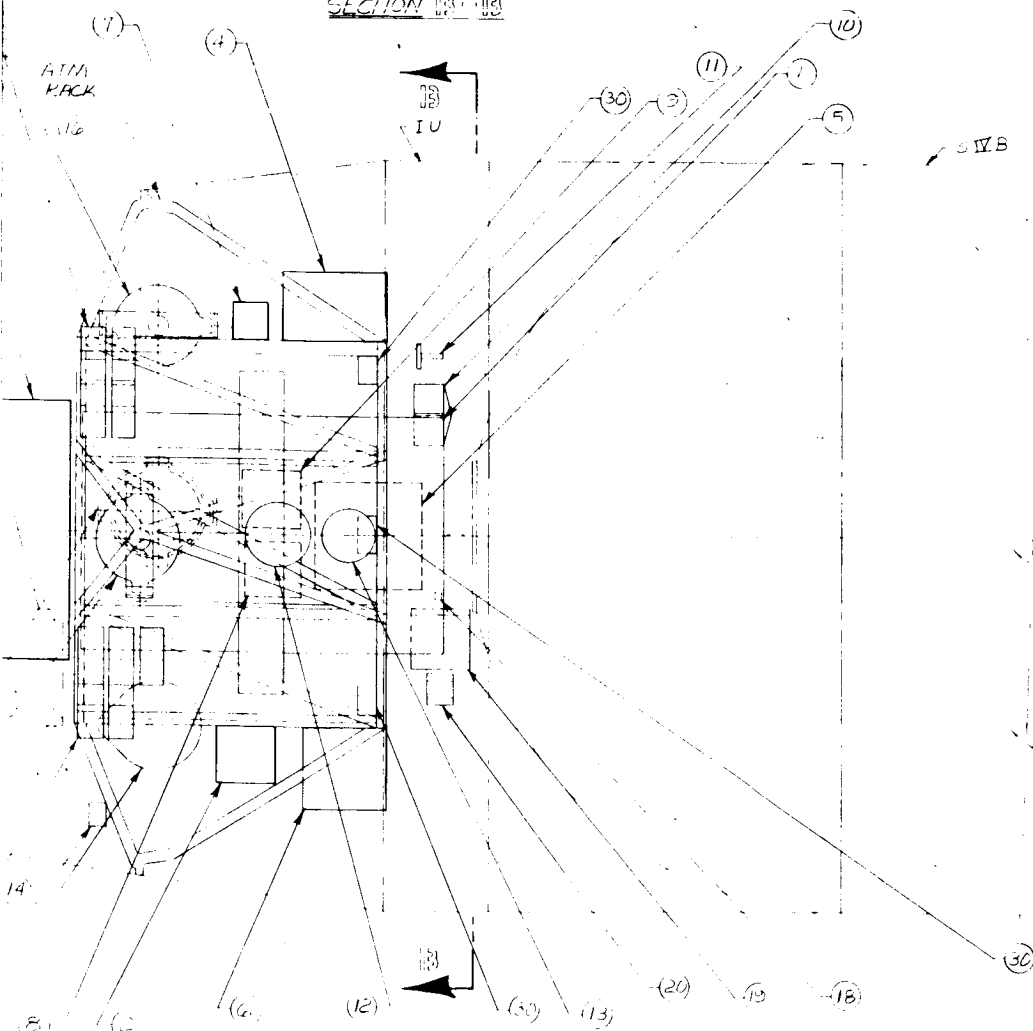
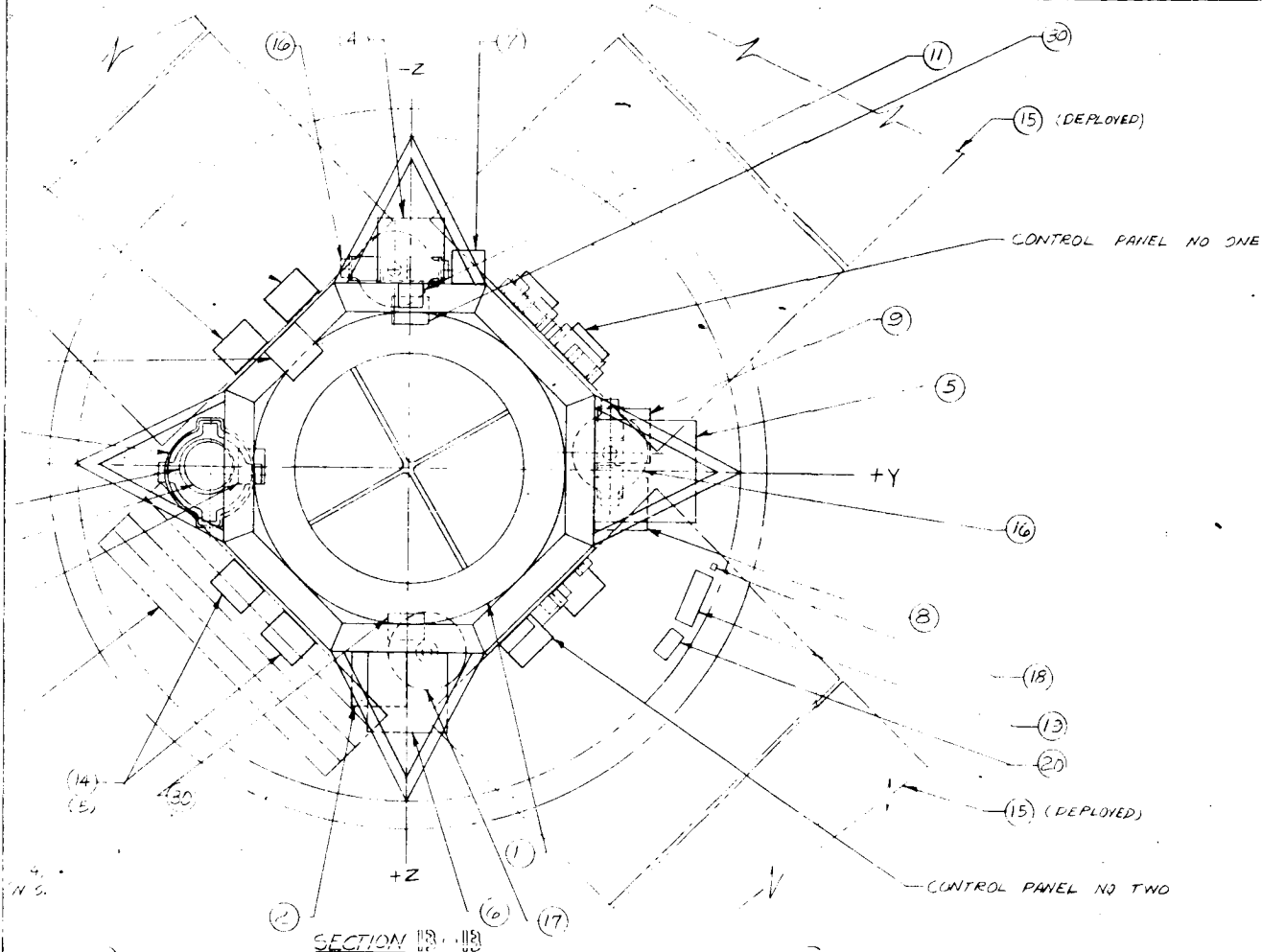
(12) -

(13) -

(30) -

(11) -
(STORED)





ITEM NO.	EXP. NO.	CONVENT	REPORT: EDR008
1	11430	APOLLO TELESCOPE MOUNT EXP. HOUSING INCLUDES: IR CELESTIAL AND PLANETARY SURVEY X-RAY ASTRONOMY UV HIGH DISPERSION SPECTROGRAPHS UV PHOTOGRAPHY LUNAR-ALPHA REGION VISIBLE PHOTOGRAPHY	DATE: 29 MAR 67 PAGE: 6-29
2	11430	LEM RELAY EXPERIMENT	
3	11440	LASER COMMUNICATION SATELLITE	
4		SIMULTANEOUS ORBIT TRACK BEACON	
5		NAVIGATION & TRAFFIC CONTROL SATELLITE	
6		LASER CLOCK RELATIVITY	
7		BARIUM RELEASE	
8		SOLAR BURST	
9		EXTENSIBLE ANTENNA FOR RADIO ASTRONOMY	
10	11440	VHF/UHF ANTENNA	
11		S BAND OMNI ANTENNA	
12		LOX TANK	
13		WATER TANK (APOLLO DESCENT STAGE)	
14		BATTERY PACKAGE (3)	
15		SOLAR ARRAY (4)	
16		CONTROL MOMENT GYRO (3)	
17		ECG WATER TANK	
18		VIDEO SWITCH	
19		ASAP RECORDER	
20		MOD 40 MULTIPLEXER CONTROL PANEL NO ONE:	
21		BATTERY PACKAGE (3)	
26		MOD 270 MULTIPLEXER	
27		MOD 410 MULTIPLEXER	
28		P.M. MOD 41	
29		COMMAND DECODER	
30		MEASURING PACK (4)	
31		ASAP RECORDER CONTROL PANEL NO TWO	
32		BATTERY PACKAGE (4)	
33		VHF/UHF TRANSMITTER	
34		UHF RECEIVER	
35		VHF/UHF MULTIPLEXER	
36		ANTENNA SYSTEM	
37		MOD 270 MULTIPLEXER	
38		GYROCOMPASSING PACKAGE	
39		CONTROL SIGNAL PROCESSING MODULE	
40		DISPLAY & CONTROL PANELS IN LEM TO SUPPORT EXP AS FOLLOWS: IR CELESTIAL & PLANETARY SURVEY PANEL X-RAY ASTRONOMY PANEL UV HIGH DISPERSION SPECTROGRAPHS PANEL UV PHOTOGRAPHY LUNAR-ALPHA PANEL VISIBLE PHOTOGRAPHY PANEL LEM RELAY EXP PANEL LASER COMMUNICATION SATELLITE PANEL SIMULTANEOUS ORBIT TRACK BEACON PANEL NAVIGATION & TRAFFIC CONTROL SATELLITE PANEL LASER CLOCK RELATIVITY PANEL BARIUM RELEASE PANEL SOLAR BURST PANEL EXTENSIBLE ANTENNA FOR RADIO ASTRONOMY PANEL	
41	11440	COMMUNICATION DISPLAY & CONTROL PANEL	
42		LEM SUPPORT DISPLAY & CONTROL PANEL	
43		NAVIGATION & TRAFFIC CONTROL DISPLAY & CONTROL PANEL	
44		LOCAL VERTICAL GYRO	
45		RADIATION VENTILATORS	

NOTE

1. CONTROL PANELS NO ONE & TWO TO BE VIEWED FROM A REAR VIEW
2. THERE IS NOT SUFFICIENT ROOM TO MOUNT EXP TOIR OPTICAL TECHNOLOGY UNIT 4" DIA X 20" LONG

FIG 132

MARTIN MARIETTA
CORPORATION
GENERAL CONFIGURATION
XCSM/LEM/ATM/IRACK
LIGHT 12 12 12 12 12 12
AAP-1082

TABLE 6.4- 16

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 13A

INJECTION CAPABILITY TO INITIAL ORBIT

68900.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

21946.
3847.
400.
4300.

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

38406.

CONFIGURATION LCSCM

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
22420.
12125.
185.

PAYLOAD ABOVE I.U.

38590.

PAYLOAD MARGIN

-184.

NOTES

80X220 N. MI. ORBIT TO 220 N. MI. CIRCULAR ORBIT

INCLINATION 28.9 DEGREES
FLIGHT 221 DESIGNATED AS FLIGHT 13A

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 6.4- 17

AAP FLIGHT NO. 13A

SPACECRAFT LCSCM
CARRIER

DESCRIPTION

LCSCM ADD-ONS

TOTAL

I DRY WEIGHT

STRUCTURE
STABILIZATION & CONTROL
NAVIGATION & GUIDANCE
CREW PROVISIONS
ENVIRONMENTAL CONTROL
DATA MANAGEMENT
COMMUNICATION
ELECTRIC PWR & DISTR
PROPULSION
RCS
RETROROCKETS
SLA RING
EARTH LANDING SYSTEM
SCIENTIFIC EQUIPMENT
GROWTH MSFC
TOTAL DRY WEIGHT
**GROSS DRY WEIGHT

9401.
226.
440.
84.
702.
480.
567.
3181.
1130.
1064.
1080.
90.
617.
80.
2301.
21443.
977.

II VARIABLE LOAD

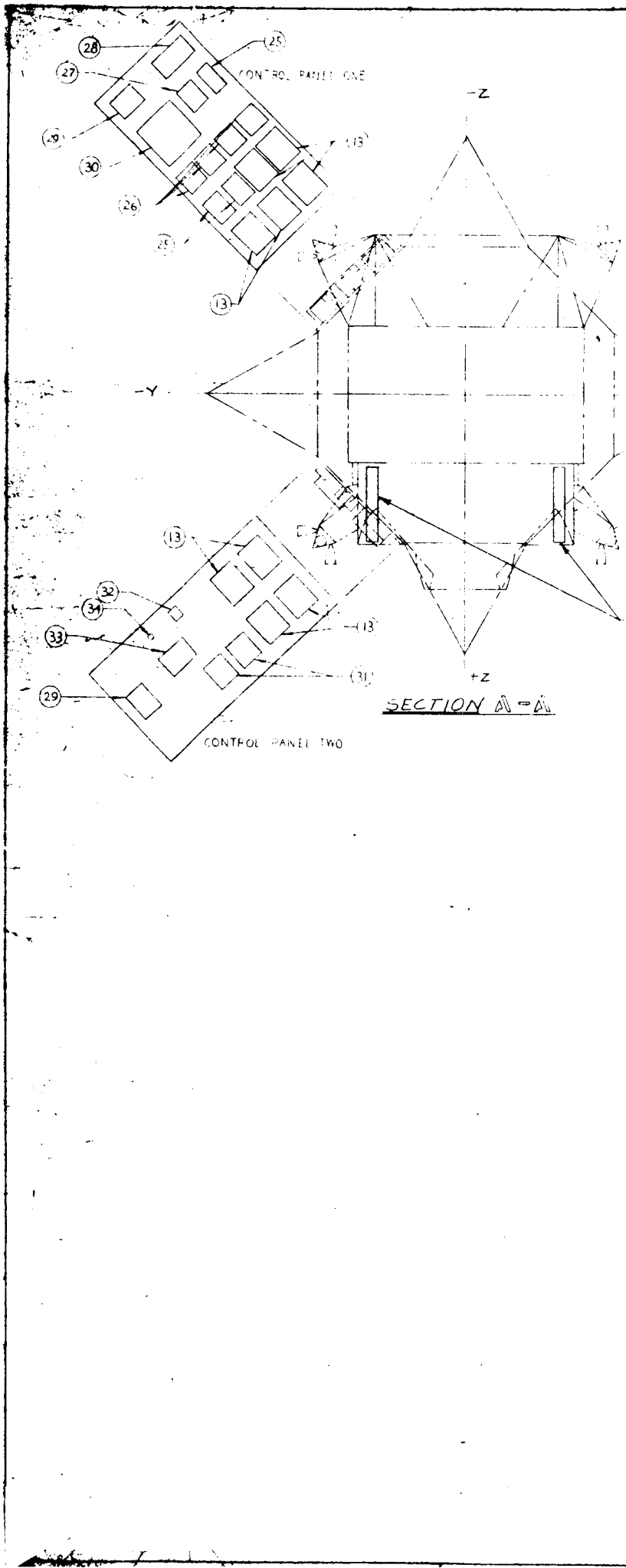
MAIN PROPELLANTS
R C PROPELLANTS
CREW PROVISIONS
ECS & LIFE SUPT
UNUSABLE SPS
TOTAL VARIABLE WEIGHT
**GROSS VARIABLE LOAD
**GROSS EXPERIMENT WEIGHT

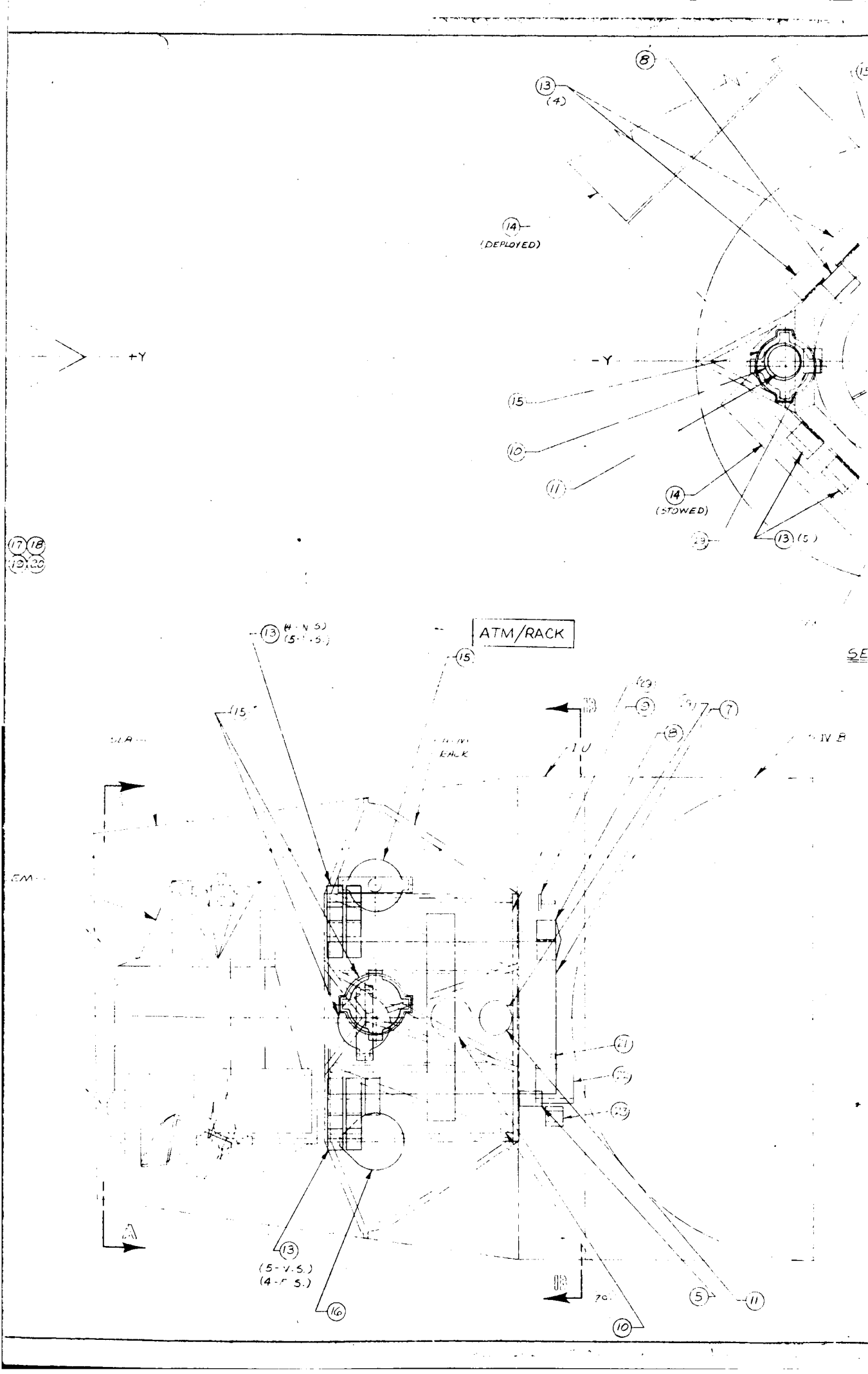
3000.
2929.
958.
460.
408.
7755.
4370.

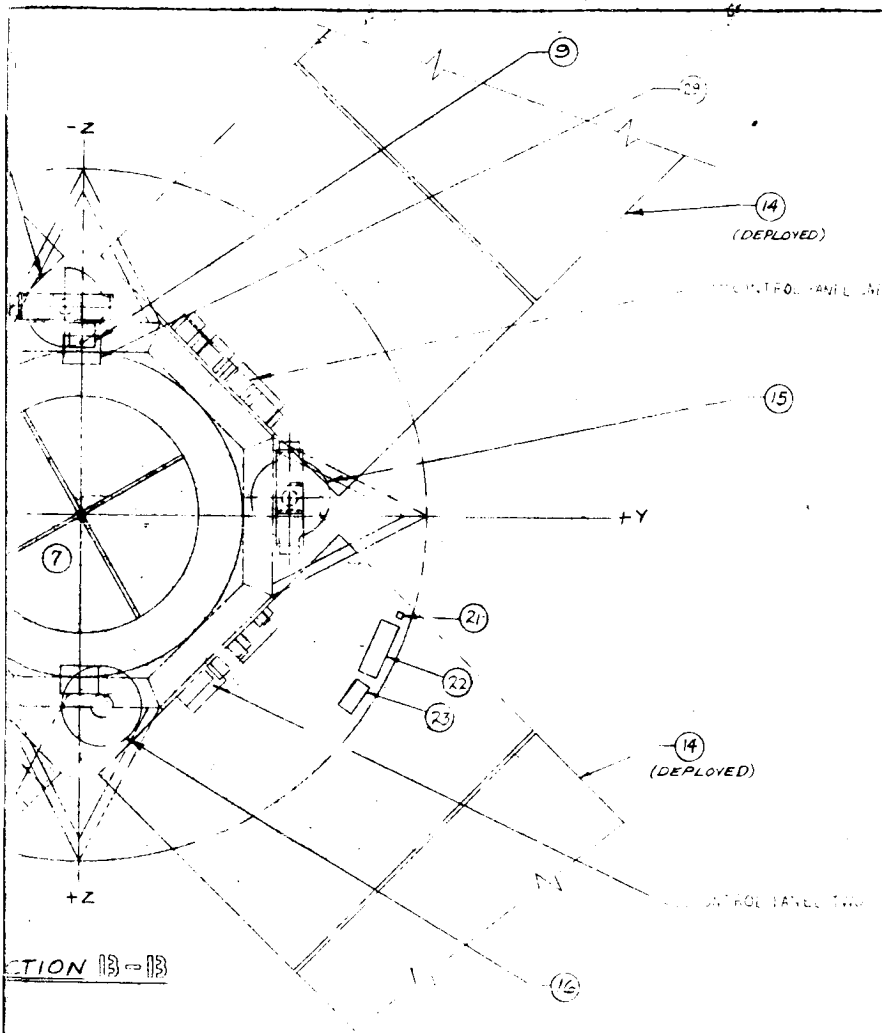
22420.

III TOTAL WEIGHT

12125.
185.
34730.







SECTION 13-13

ITEM NO	EXP NO	COMPONENT
1		
2		
3		NUMBERS NOT USED
4		
5		
6		
7		APOLLO TELESCOPE MAINT EXP. LIST'S INCLUDES: H ₂ TELESCOPE S052 WHITE LIGHT CORONOGRAPH CAMERA, ETC. S053A UV CORONAL SPECTROGRAPHS CAMERA, ETC. S053B UV SPECTROGRAPH CAMERA, ETC. S054 X-RAY SPECTROGRAPHIC TELESCOPE CAMERA, ETC. S055A UV SPECTROMETER CAMERA, ETC. S055B UV SPECTROHELIOMETER CAMERA, ETC. S055C UV SPECTROMETER - H ₂ TELESCOPE ETC. S056 X-RAY TELESCOPE, ETC.
8	SUB SYST ADD ON	VHF/LINE ANTENNA
9		S BAND OMNI ANTENNA
10		LOX TANK
11		WATER TANK (APOLLO DESENT STAGE)
12		H ₂ TANK (150)
13		BATTERY (9)
14		SOLAR ARRAY (4)
15		CONTROL MOMENT GYRO (3)
16	SUB SYST ADD ON	ECS WATER TANK
17		DISPLAY & CONTROL PANELS IN LEM TO SUPPORT EXP. ARE AS FOLLOWS S020 UV X RAY SOLAR PHOTOGRAPHY PANEL S052 WHITE LIGHT CORONOGRAPH PANEL S053A UV CORONAL SPECTROGRAPHS PANEL S053B UV SPECTROGRAPH PANEL S054 X-RAY SPECTROGRAPHIC TELESCOPE PANEL S055A UV SPECTROMETER PANEL S055B UV SPECTROHELIOMETER PANEL S055C UV SPECTROMETER - H ₂ TELESCOPE PANEL S056 X-RAY TELESCOPE PANEL
18	SUB SYST ADD ON	COMMUNICATION DISPLAY & CONTROL PANEL
19		LIFE SUPPORT DISPLAY & CONTROL PANEL
20		GUIDANCE & CONTROL DISPLAY & CONTROL PANEL
21		VIDEO SWITCH
22		ASAP RECORDER
23		MOD 410
24		CONTROL PANEL ONE
25		BATTERIES (4)
26		MODEL 270 MULTIFLEXER
27		MODEL 410 MULTIFLEXER
28		MODEL 410
29		COMMON TELECOM
30		REPAIRING RACK
31		ASAP RECORDER
32		CONTROL PANEL TWO
33		DATA RECORDER
34		VIDEO TRANSMITTER
35		VIDEO RECEIVER
36		VIDEO MULTIFLEXER
37		ANTENNA SWITCH

NOTE:
 CONTROL PANELS ONE AND TWO DO NOT APPEAR ON PROFILE VIEW

FIG 7.3.3

MARTIN-MARIETTA CORPORATION	
GENERAL CONFIGURATION	
LEM / ATM / RACK	
111GHT 36	MISSION A5522
38597	AAP-1078
102	

TABLE 6.4-18
EXPERIMENT LIST - MAP FLIGHT 13A

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
T006	Vision Test Equipment Evaluation	CM	CM	12	8
T015	Meteoroid Composition	SM	Deploy	25	12
M433	Satellite Recovery	CM/SM	CM	100	26

NOTES: Total net weight - 137 pounds
Total gross weight - 185 pounds

TABLE 6.5-1 RECOMMENDED SUBSYSTEM CHANGES

CARRIER LCSM (Modified)

FLIGHT 9

ED-2002-59
29 March 1967

6-27

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Electric Power	Remove	Power will be supplied from the AM Solar Array	Fuel Cell System incl. 3 Fuel Cells	22.5" Dia. x 44" H. each	846 lbs.
			GH ₂ System, incl. 2 GH ₂ Tanks	31.8" Dia. Sphere each	152 lbs.
			GO ₂ System, partial removal (194 lbs. - 108 lbs.); tanks reg'd. for life support		
Propulsion	Add	Required for 7 day contingency	10 - Batteries E. P. P/N 4194, Ag-Zn	14"L x 12"W x 8.5" H	86 lbs.
	Remove	Not req'd for mission	2 SPS tanks, incl. plumbing	51" Dia. x 155"	118 lbs. each
	Remove	Required for 2844 pounds of RCS propellant	RCS Fuel System	--	586 lbs.
			RCS Oxidizer System	--	80 lbs.
			RCS Pressurization System	--	86 lbs.
	Add	Replacement	RCS Fuel System	--	94 lbs.
		Replacement	RCS Oxidizer System	--	210 lbs.
		Replacement	RCS Pressurization System	--	213 lbs.
		Increase propellant capacity to 2814 lbs.	4 - Propellant Tanks	12.5" Dia. x 29"	239 lbs.
			4 - He Supply Tanks	8.8" Sphere	58 lbs.
			Plumbing for above	--	7 lbs.

TABLE 6.5-2

RECOMMENDED SUBSYSTEM CHANGES

CARRIER LCSCM (Modified)

FLIGHT 9

ED-2002-59
29 March 1967

6-28

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT
Propulsion	Add	Keep propellants from freezing	RCS engine heaters	--	Negligible
	Add	Keep propellants from freezing	SPS propellant line heaters	--	Negligible
Communications		CSM/MDA interface	1 - TM Hardline	2" OD x 24"	2.2 lbs.
			1 - Voice Hardline	2" OD x 24"	2.2 lbs.

TABLE 6.5-3

RECOMMENDED SUBSYSTEM CHANGES

CARRIER LCSM (Modified)

FLIGHT 9

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE (in)	WEIGHT (lb)
Life Support	Add	Water for 93 day mission	Water Tanks #1	12.55 OD x 17.12	73 (wet)
			#2	Existing	Δ22 (wet)
				28.4 OD x 32.5	692 (wet)
			Total Net Change		787 (wet)
	Remove	Food for 7 day contingency only	Food	1.43 Ft ³	-44
	Remove	Contingency Personal Hygiene	Personal Hygiene	0.78 Ft ³	-21
	Add	Water Conservation Equipment	H ₂ O Reclamation	6 Ft ³	140
	Remove	7 day contingency	L10H 16 each	-2.56 Ft ³	-76

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Guidance & Control	Add	Provide Required Pointing Capability For Application "B" Experiments	1 - Horizon Sensor	0.3 Ft ³	15 lbs.
			1 - Gyrocompassing Gyro Package	0.3 Ft ³	18 lbs.
			1 - Control Signal Processing Module	0.5 Ft ³	36 lbs.
Data Management	Add	Provide System to Support Experiments	3 - CMG's	14.0 Ft ³ each	170 lbs. each
			Servo Electronics	3.0 Ft ³	200 lbs.
			1 - 3 Axis Gyro Package	0.5 Ft ³	20 lbs.
			1 - CSM PCM	1. Ft ³	40 lbs.
			1 - CSM Recorder	1. Ft ³	40 lbs.
			1 - Time	Neg.	2 lbs.
			1 - Video Switch	Neg.	2 lbs.
			Command Relay Matrix	Neg.	8 lbs.

TABLE 6.5.5

RECOMMENDED SUBSYSTEM CHANGES

CARRIER AMFLIGHT 10

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Electric Power	Remove	Supply electric power for a 90 day period. The solar array system will supply power to the cluster (OWS-2) for each of the 4 - 90 day missions	4 - Batteries, AG-ZN	12"L x 6"H x 6"W each	19.5 lbs. each
			6 - CH ₂ Tanks	27" Dia. Sphere each	76 lbs. each empty
			12 - GO ₂ Tanks, if tanks are not reg'd. for life support	22" Dia. Sphere each	50.75 lbs. each empty
	Add		1 - Solar Array	766 Ft ²	1400 lbs.
			17 - Battery Packages	16.5"H x 13"W x 8"L each	80 lbs. each
			2 - Inverters	14.8"L x 14.5"W x 6.8"H ea.	40 lbs. each
			1 - Distribution Sys.	800 in ³	115 lbs.
	Add	Supply power to the CSM's during the 90 days of flight attached to the OWS-2 (cluster)	Power Interface From AM to CSM's (216, 218, 220, 221)	TBS	TBS

TABLE 6.5-6

RECOMMENDED SUBSYSTEM CHANGES

CARRIER AM FLIGHT 10

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Data Management	Add	To Meet Mission Requirements	1 - Discrete Multiplexer	.2 ft ³	2.27 kg
			1 - CSM PGM	1.0 ft ³	18.20 kg
			1 - CSM Recorder	1.0 ft ³	18.20 kg
			1 - Time	Neg.	.91 kg
			1 - Timing & Audio Mixer	.2 ft ³	3.20 kg
Communications			1 - Video Switch	Neg.	.91 kg
			Command Relay Matrix	Neg.	3.65 kg
	Add	Provides Connection of CSM Voice to AM VHF/FM Transceiver	AM/CSM Hardline	*2.5 ft ³	*2.2 lbs.
	Add	Provides 15 Watts RF Output	2 - VHF/FM TM Transmitters	12.9" x 10.5" x 3.7"	15.0 lbs.
	Add	For Optimum Antenna Selection	1 - Antenna Selector Switch	2" x 2" x 4"	2.2 lbs.
	Add	Connect AM XMTRS & S-IVB Mounted Antennas	1 - Coax Cable	1" dia.	*50 lbs.

TABLE 6.5-7 RECOMMENDED SUBSYSTEM CHANGES

CARRIER AM FLIGHT 10ED-2002-59
29 March 1967

6-33

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Communications	Add	Connect AM TM to CSM RF Link for Periods of AM Antenna Masking	AM/CSM TM Hardline	**2" OD x 24"	** 2.2 lbs.
	Remove	Insufficient RF Power Output	2 - VHF/FM Transmitters	.02 ft ³	25.0 lbs.
* Total for AM & S-IVB					
** Total for AM & CSM					
Thermal Control	Add	Control SIVB temperature	Circulation fans (storage only)		
Structures	Add	Seal SIVB tank	6 tank penetration sealing kits		

TABLE 6.5-8 RECOMMENDED SUBSYSTEM CHANGES

CARRIER MDA FLIGHT 10

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Guidance & Control	Add	Sensor System Req'd. for Orientation of Experiment T014	Star Tracker System	1.4 Ft ³	50 lbs.

TABLE 6.5-9

RECOMMENDED SUBSYSTEM CHANGES

CARRIER S-IVB

FLIGHT 10

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
APS	Add	Increase thermal life of system to 7½ hours	Fiberglass insulation to critical areas of APS system	--	Negligible
Electric Power	Add	Power Distribution	Electrical cabling	-	-
Communications	Add	Connection between AM XMTS and S-IVB mounted antennas (includes fittings and aluminum channel). Provide optimum antenna selection. Provide x-axis antenna coverage.	Coax cable Antenna coaxial switch 2 VHF antennas	*144 in. ³ 6 in. ³ 12 in. ³	*50 lbs. 1 lb. 1 lb.
Thermal Control	Add	Control insulation flammability Control tank temperature Control film coefficient	Interior coating (dynatherm) Exterior paint Provisions for thermal curtains and fan installation.	-- -- --	-- -- --
Crew Station	Add	Crew mobility and restraint. Crew restraint during tank sealing, fire detection equipment. Crew restraint during EVA	Mobility aids. Handholds, tether fittings, fire detection equipment Handholds, tether fittings.	-- -- --	-- -- --
Propulsion	Add	Vent hydrogen tank Vent helium spheres	1-1/2 inch pressurant line external valve. Install vent line and 3 inch hand valve	-- --	-- --
Structures	Add	Facilitate equipment installation in hydrogen tank. Meteoroid protection Facilitate Manhole Cover removal Crew quarters Crew quarters Crew safety Stow manhole cover AM/S-IVB compatibility SLA panel control Crew quarters	112 tank attach fittings Meteoroid bumper(exterior) QD manhole cover Crew quarter partitions Tank floor. H ₂ tank protective padding. Manhole cover brackets AM flexible boot attach kit SLA panel tie downs Tank ceiling	-	800 lbs.

*Totals for AM and S-IVB.

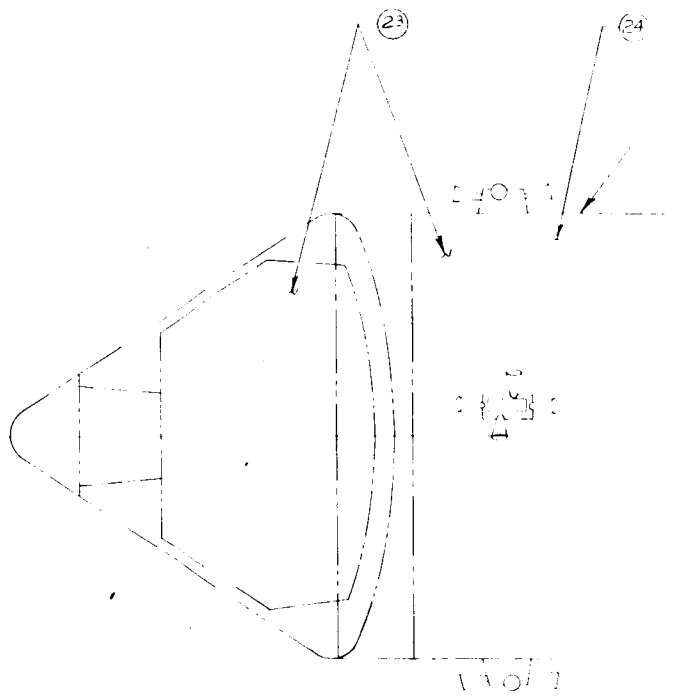
SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE in.	WEIGHT lbs.
Propulsion	Add	Keep propellants from freezing	RCS engine heaters	--	Negligible
	Add	Keep propellants from freezing 90 day consumable	SPS propellant line heaters N ₂ Tank 3 each O ₂ Tank 2 each	-- 26.3 OD 41.5 OD x 44.0	Negligible 899 (wet) 3186 (wet)
Life Support	Remove		O ₂ Tank 1 each LiOH 16 each	26.3 OD 2.56 Ft ³	-406 (wet) -76
	Add		H ₂ O 1 each	12.55 OD x 17.12	73 (wet)
				Existing	22 (wet)
			2 each Food 64 man days	28.4 OD x 32.5 18.7 Ft ³	692 (wet) 492
			Personal Hygiene 64 man days	10.2 Ft ³	234

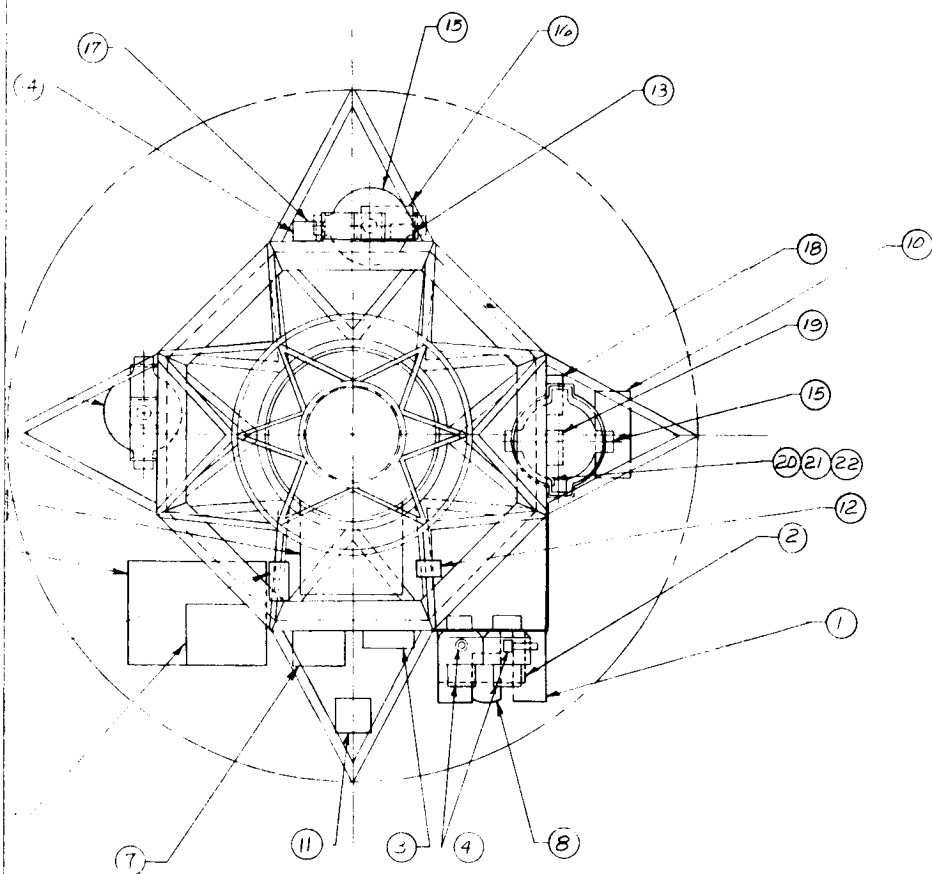
(15)

(16)

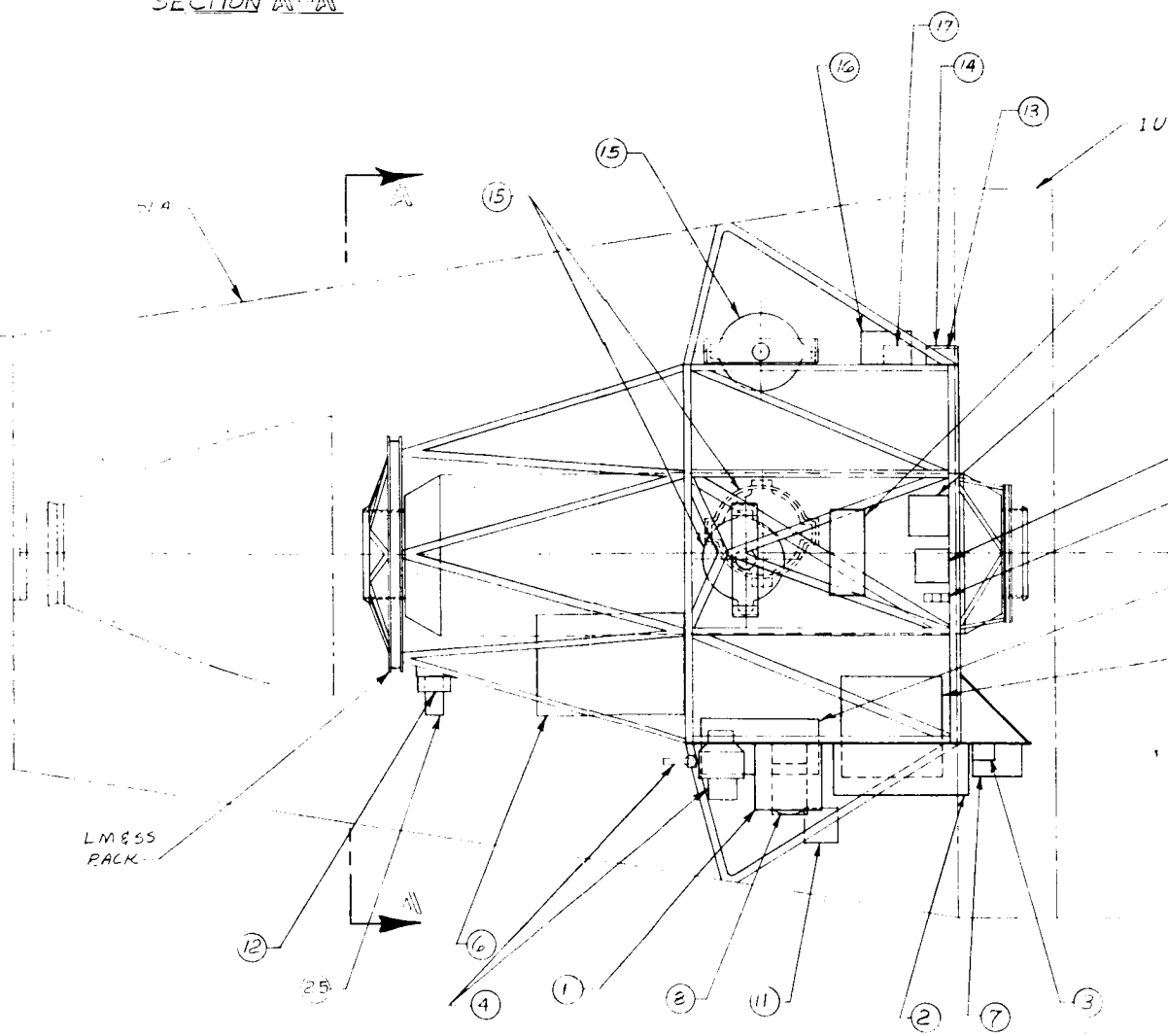
(5)

(25)

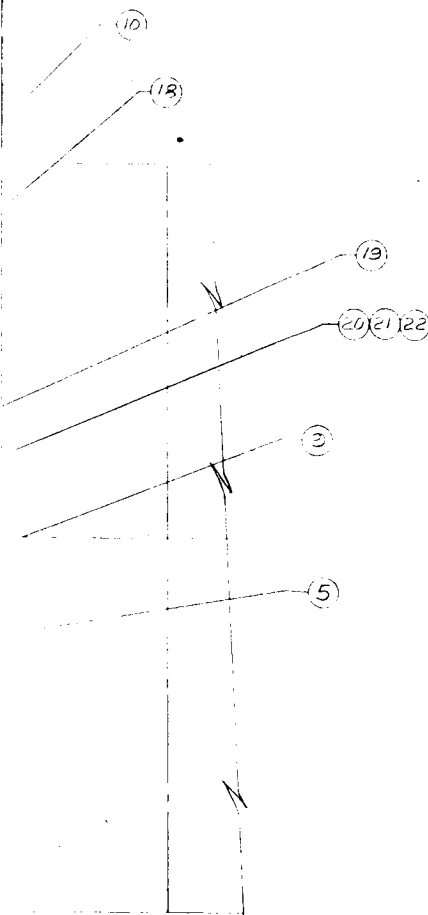




SECTION A-A

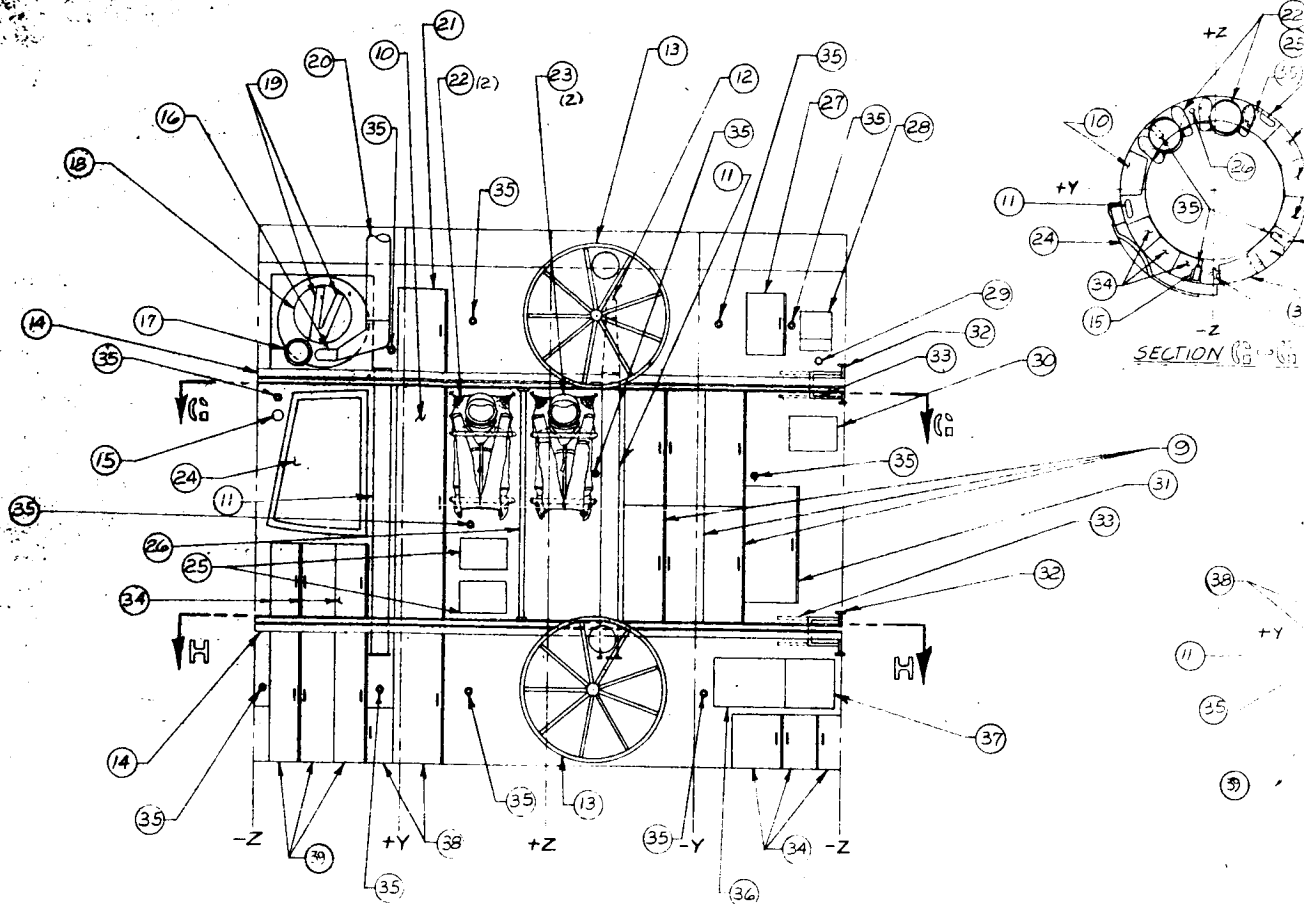


ITEM NO	EXP. NO.	COMPONENT	REPORT: ED 2002-59
			DATE: 29 MARCH 67
			PAGE: 6-37
1		UV IMAGER / SPECTROMETER	
2		SYNOPTIC MULTIBAND CAMERA	
3		SCANNING UV, VISIBLE & IR ABSORPTION SPECTROMETER	
4		METRIC & STELLAR CAMERA (2 EACH)	
5		HIGH RESOLUTION PANORAMIC CAMERA SYSTEM	
6		MULTISPECTRAL TRACKING TELESCOPE	
7		UV REMOTE SENSING MEASUREMENTS	
8		INFRARED SPECTROMETER / RADIOMETER	
9		PASSIVE INFRARED SPECTROMETER / IMAGER	
10		BROAD BAND SPECTRAL SCANNER	
11		COSMIC RAY NEUTRON ALBEDO MEASUREMENTS	
12	SUB SYST ADD ON	HORIZON SENSOR	
13		GYROCOMPASSING GYRO PACKAGE	
14		CONTROL SIGNAL PROCESSING MODULE	
15		CONTROL MOMENT GYRO (3)	
16		SERVO ELECTRONICS	
17		3-AXIS GYRO PACKAGE	
18		CSM PCM	
19		CSM RECORDER	
20		TIMER	
21		VIDEO SWITCH	
22		COMMAND RELAY MATRIX	
23		FOLLOWING EQUIPMENT IS LOCATED IN THE CSM: SCANNING UV, VISIBLE & IR ABSORPTION SPECTROMETER DISPLAY & CONTROL PNL UV IMAGER / SPECTROMETER DISPLAY & CONTROL PNL SYNOPTIC MULTIBAND CAMERA DISPLAY & CONTROL PNL METRIC CAMERA DISPLAY & CONTROL PNL HIGH RESOLUTION PANORAMIC CAMERA SYSTEM DISPLAY & CONTROL PNL MULTISPECTRAL TRACKING TELESCOPE DISPLAY & CONTROL PNL UV REMOTE SENSING MEASUREMENT DISPLAY & CONTROL PNL INFRARED SPECTROMETER / RADIOMETER DISPLAY & CONTROL PNL INSEC 23 CROSS BEAM CORRELATION DISPLAY & CONTROL PNL ANTENNA BREAKDOWN MEASUREMENT DISPLAY & CONTROL PNL COSMIC RAY NEUTRON ALBEDO MEASUREMENTS DISPLAY & CONTROL PNL BATTERY (10), L-OX TANK (2) L-OH CANISTER FOOD SUPPLIES PERSONAL HYG. PNL WATER TANK (4) PRIMATES IN LONG TERM ZERO G LASER ALTIMETER	
24	TOOD		
25			

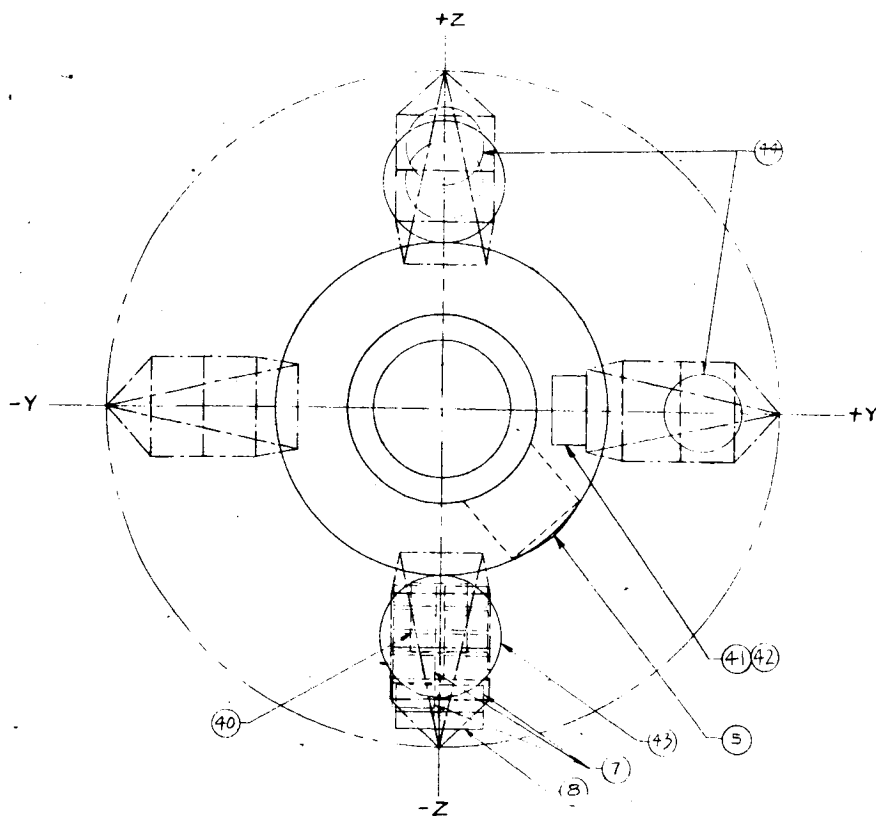


S IV B

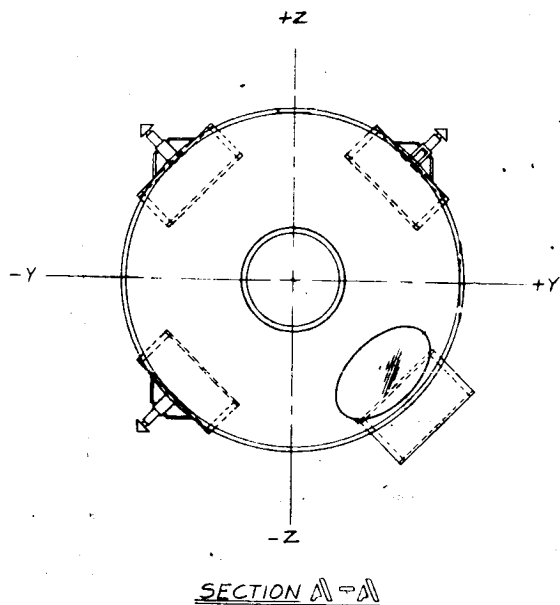
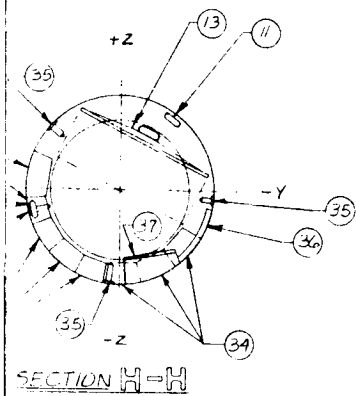
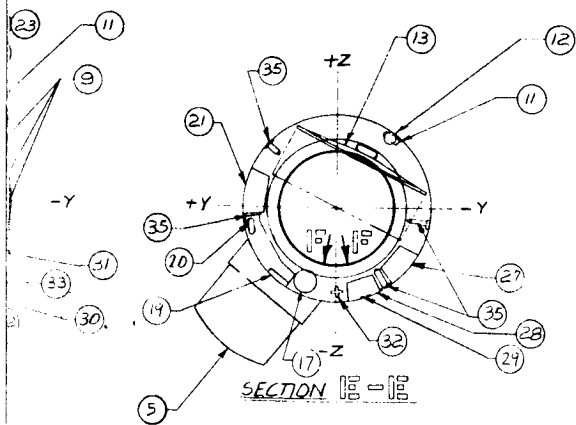
FIG 63-1
 MARTIN MARIETTA
 CORPORATION
 GENERAL CONFIGURATION
 CSM / LM 55 / RACK
 WEIGHT 29 VISION #AS216
 38597 AAP-1074



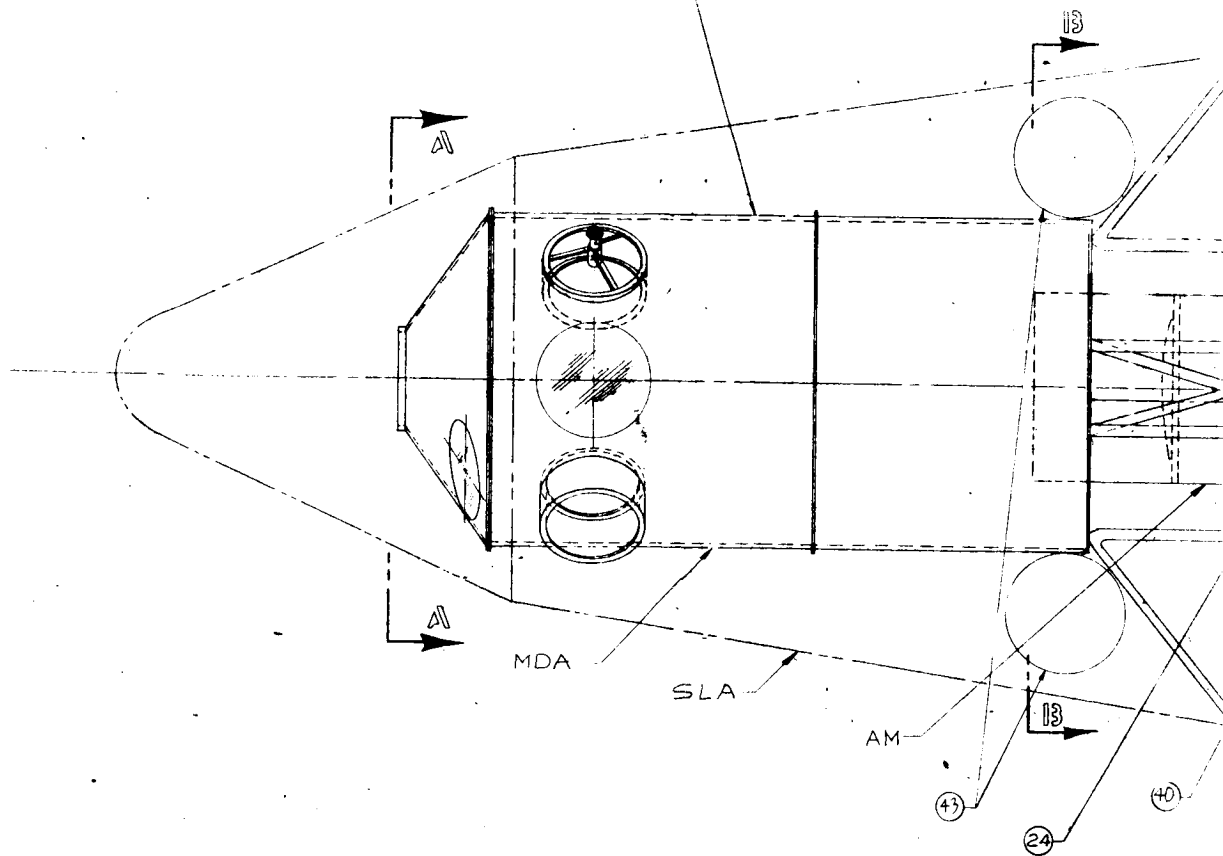
VIEW 13-13 AM TUNNEL INTERIOR STRETCH OUT
FOR COMPONENTS ON AM OUTSIDE OF
TUNNEL, SEE DRAWING OF AM IN MCDONNELL
REPORT NO E553

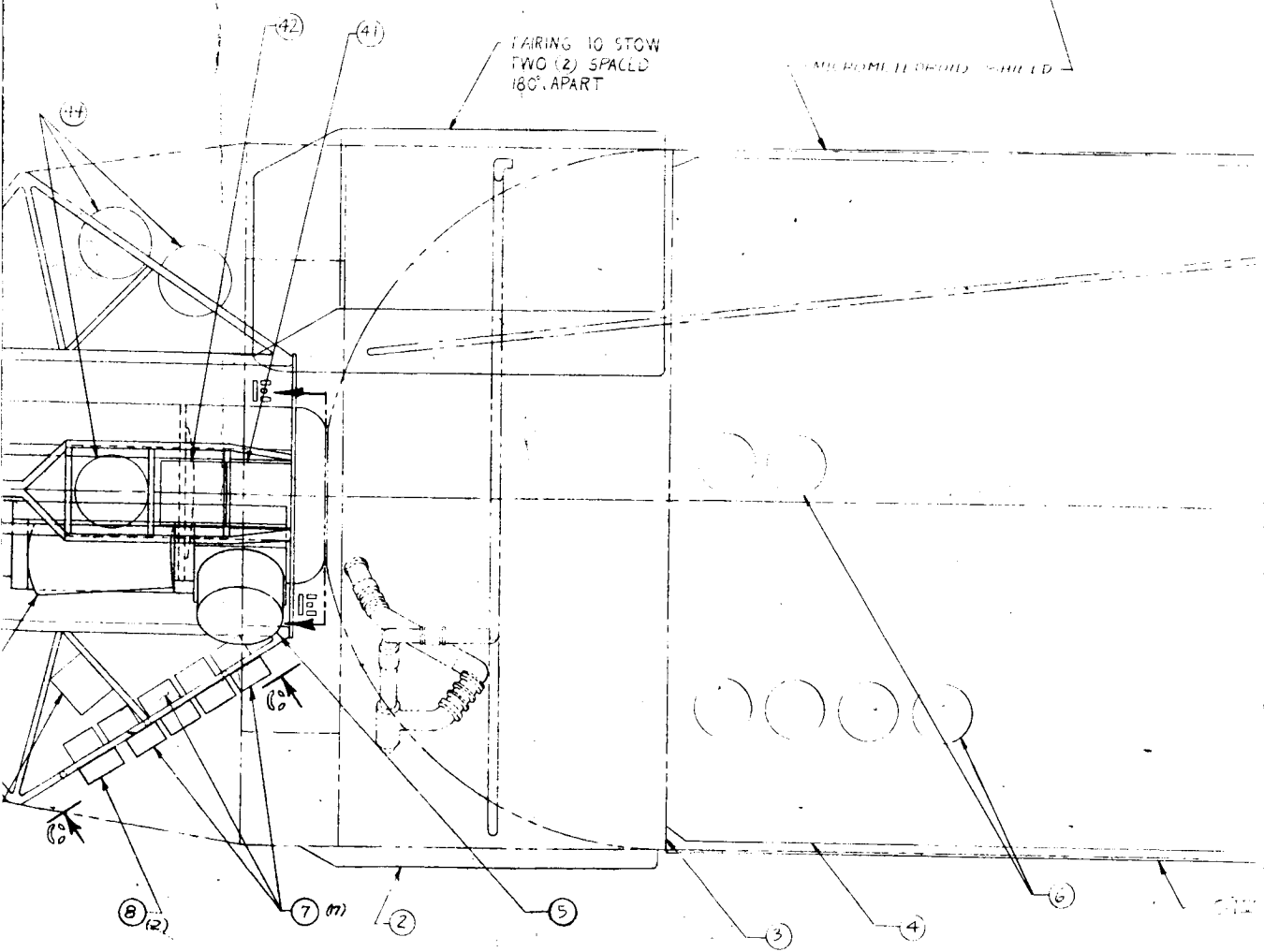
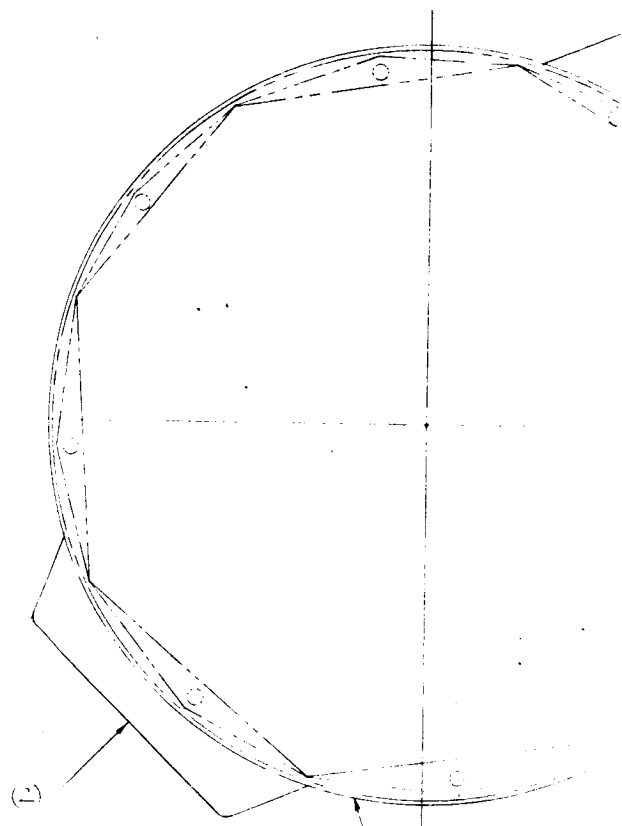


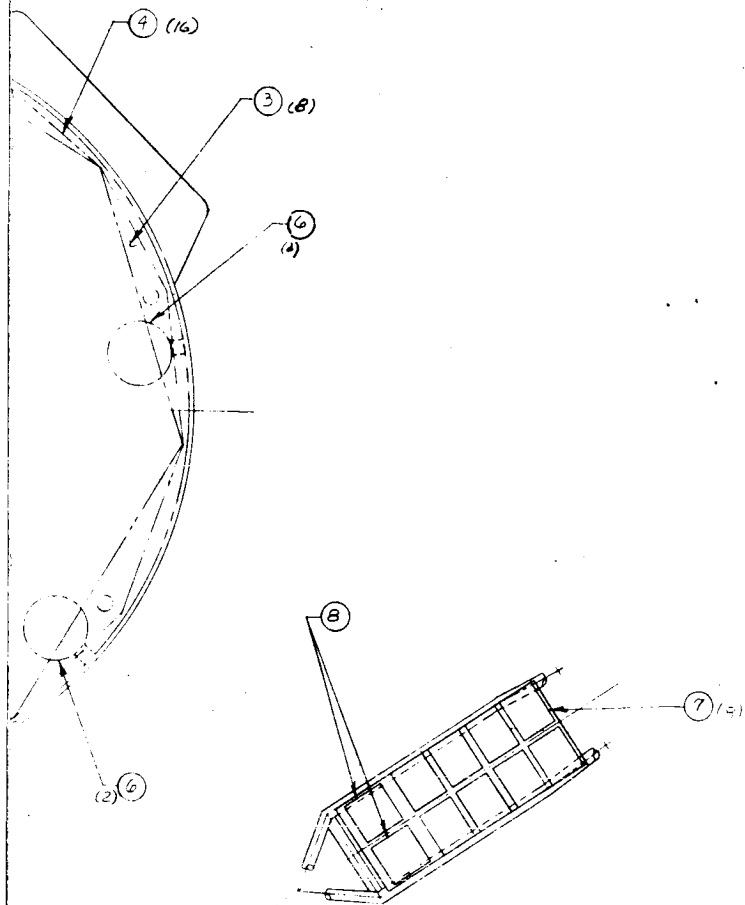
SECTION 13-13



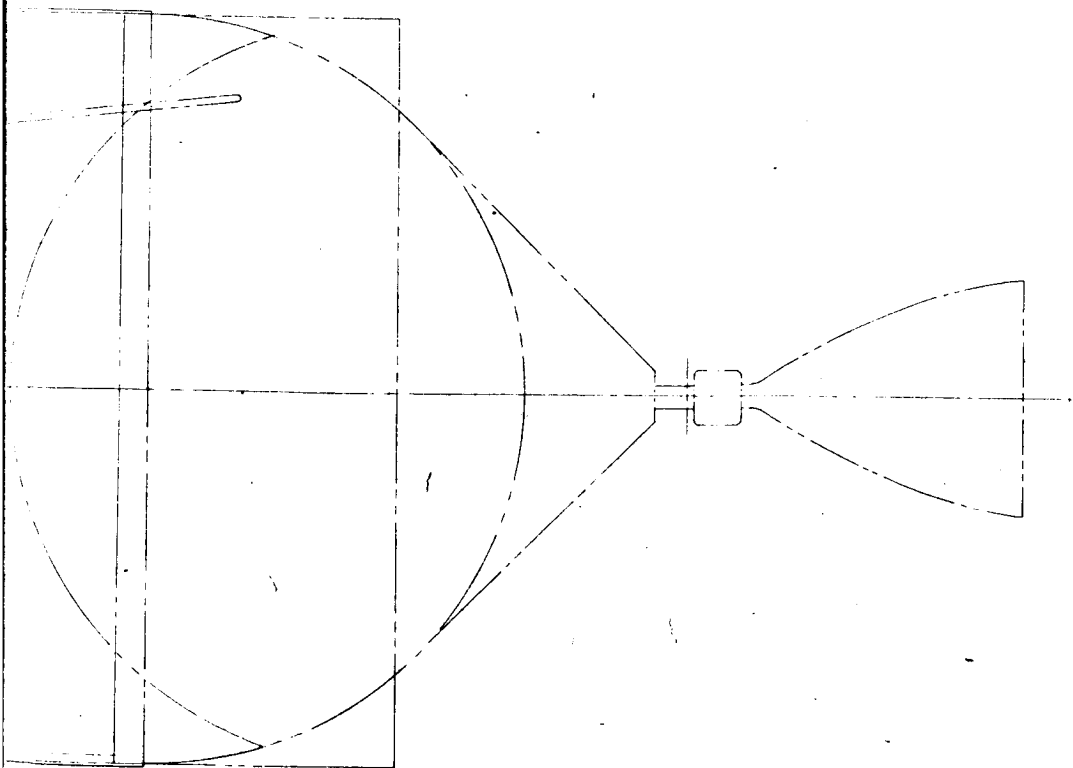
SEE SHEET 2 FOR DETAIL
OF INSIDE MDA







VIEW (C-C)



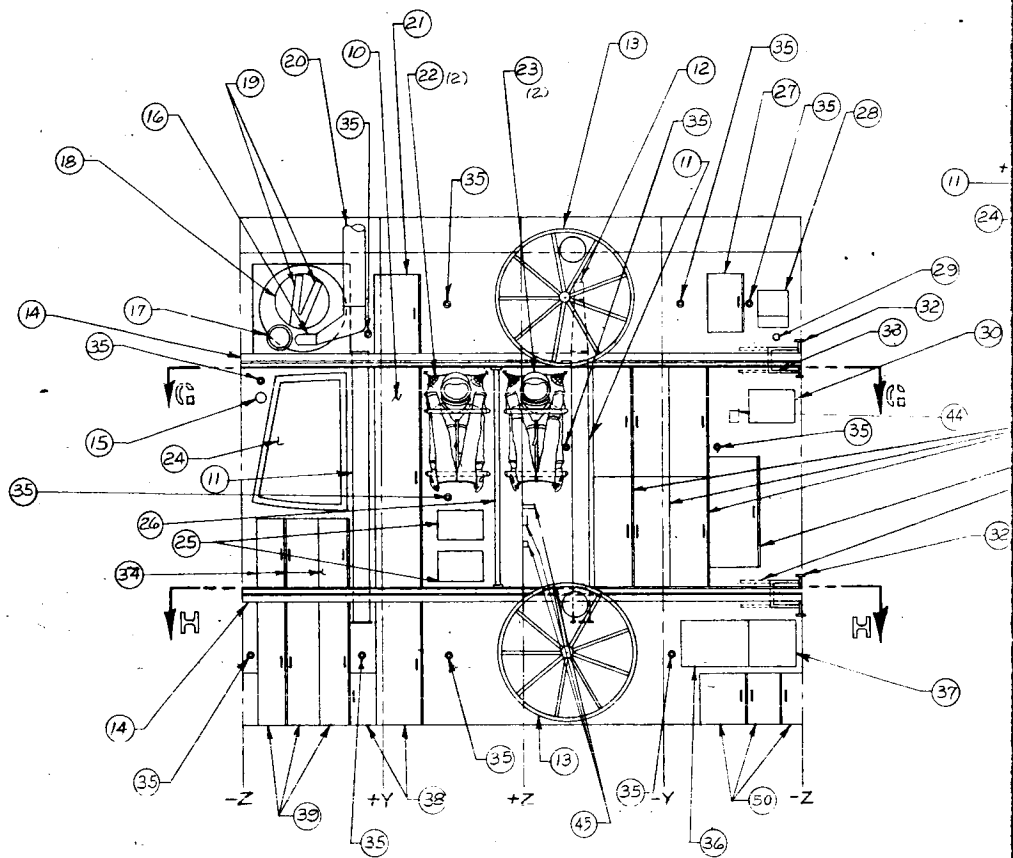
ITEM NO	EXP NO	COMPONENT	REPORT ED 2002-59
1		NUMBER NOT USED	DATE 29 MARCH 1967
2	ADD ON	SOLAR ARRAY (790 FT)	PAGE 6-38
3		PLENUM COVER (8)	
4		THERMAL CONTROL SLEEVE (16)	
5		ECS PACKAGE COVER	
6		HELIUM SPHERE (6)	
7	SUB SYST	BATTERY PACKAGE (17)	
8	ADD ON	INVERTER (2)	
9		DATA MANAGEMENT - CONSISTS OF THE FOLLOWING: COMMAND RELAY MATRIX DISCRETE MULTIPLEXER TIMING & AUDIO MIXER CSM RECORDER VIDEO SWITCH CSM PCM	
10		EVA UMBILICAL & 10' TRANSITION UMBILICAL STOWAGE	
11		VENTILATION DUCT (2)	
12		FAN ASSY	
13		AIRLOCK HATCH (STOWED)	
14		DEBRIS GUARD (2)	
15		EQUALIZATION VALVE	
16		TUNNEL VENT VALVE	
17		TANK	
18		ECS CANISTER	
19		SOLIDS TRAP INLET & COMPRESSOR	
20		POLYETHYLENE DUCT	
21		SIB LIGHT ASSY (PORTABLE) & EXTENSION STOWAGE	
22		NET HELMET RETAINER (2)	
23		ASTRONAUT SUIT STOWAGE (2)	
24		EGRESS HATCH	
25		CHEST PACK (2)	
26		HANDRAIL	
27		UTILITY LIGHT & EXT CHORD WIRE BUNDLE	
28		AH INST PANEL	
29		OXYGEN VENT	
30		CENTER INST PANEL AIRLOCK CONTROL	
31		HHMU & SUPPLY BOTTLE SPACE TOOL & REPAIR KIT STOWAGE	
32		AIRLOCK PRESSURIZATION VALVE (2)	
33		HANDLE & GEARBOX ASSY	
34		ENTER STOWAGE SPACE (2)	
35		LIGHT ASSY (12)	
36		FWD INST PANEL	
37		INST PANEL	
38		CAMERA EQUIPMENT STOWAGE	
39		FOOD, PERSONAL HYGIENE & WASTE MGMT HARDWARE	
40		AIRLOCK DISTRIBUTION SYSTEM	
41		MOLECULAR SIEVE	
42		TUNNEL GAS CONTROL	
43		OXYGEN SUPPLY TANK (2)	
44		NITROGEN SUPPLY TANK (1)	

NOTES:

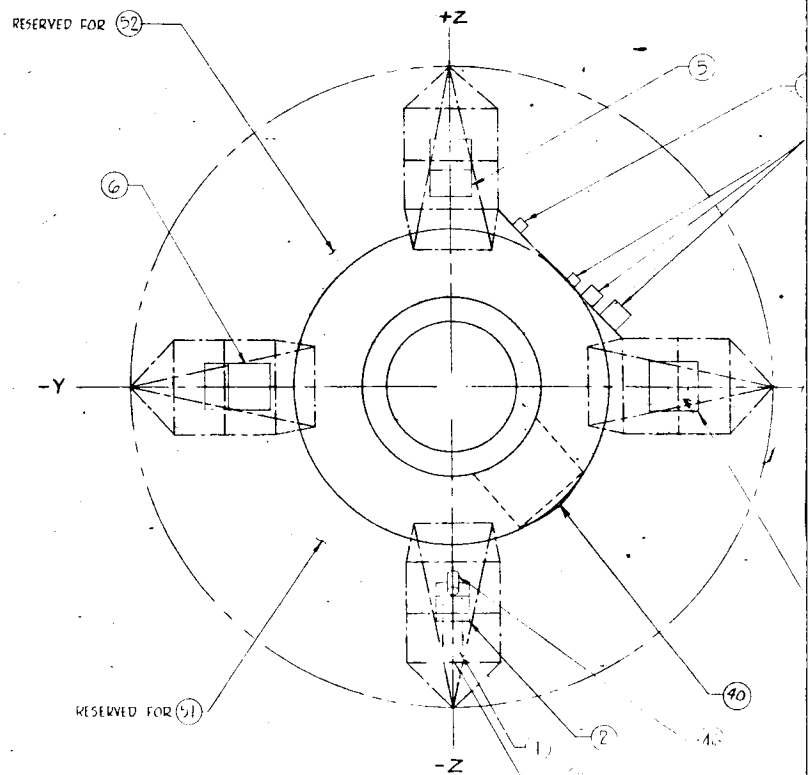
1. PRELAUNCH CREW QUARTER PROVISIONS IN THE SIB TO BE SUPPLIED.

FIG. 6.3-2

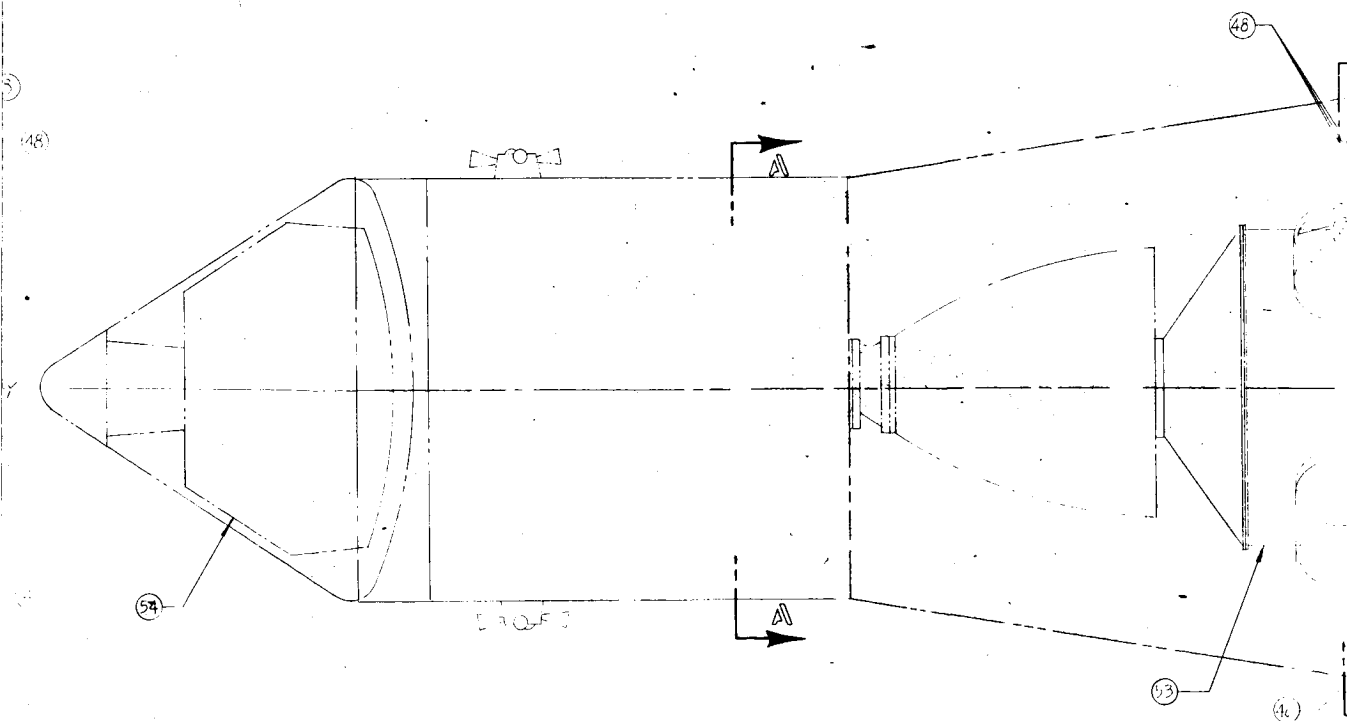
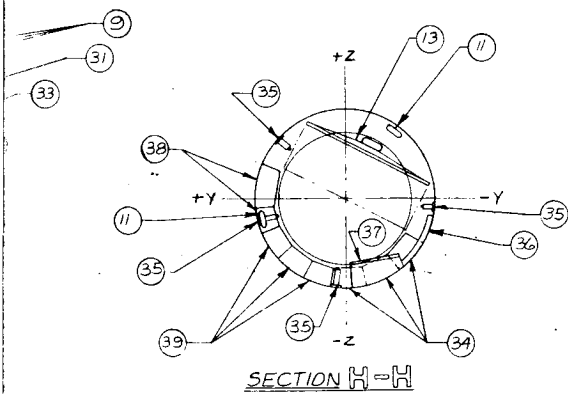
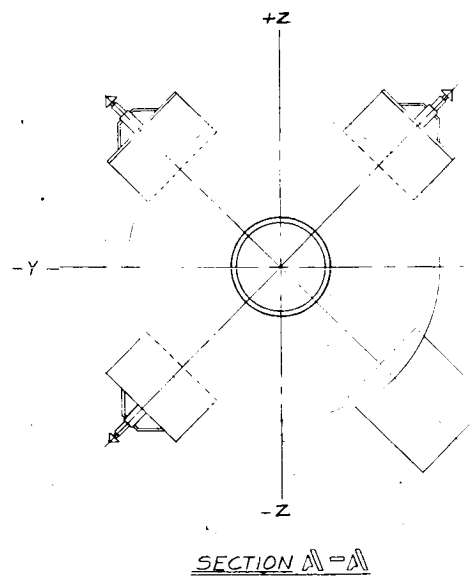
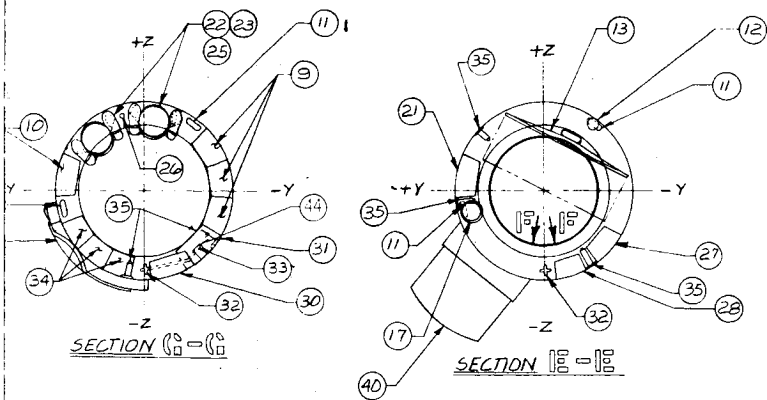
MARTIN MARIETTA CORPORATION	
GENERAL CONFIGURATION	
MDA / AM / SIB	
FLIGHT "10" MISSION "217"	
38597	AAP-1072



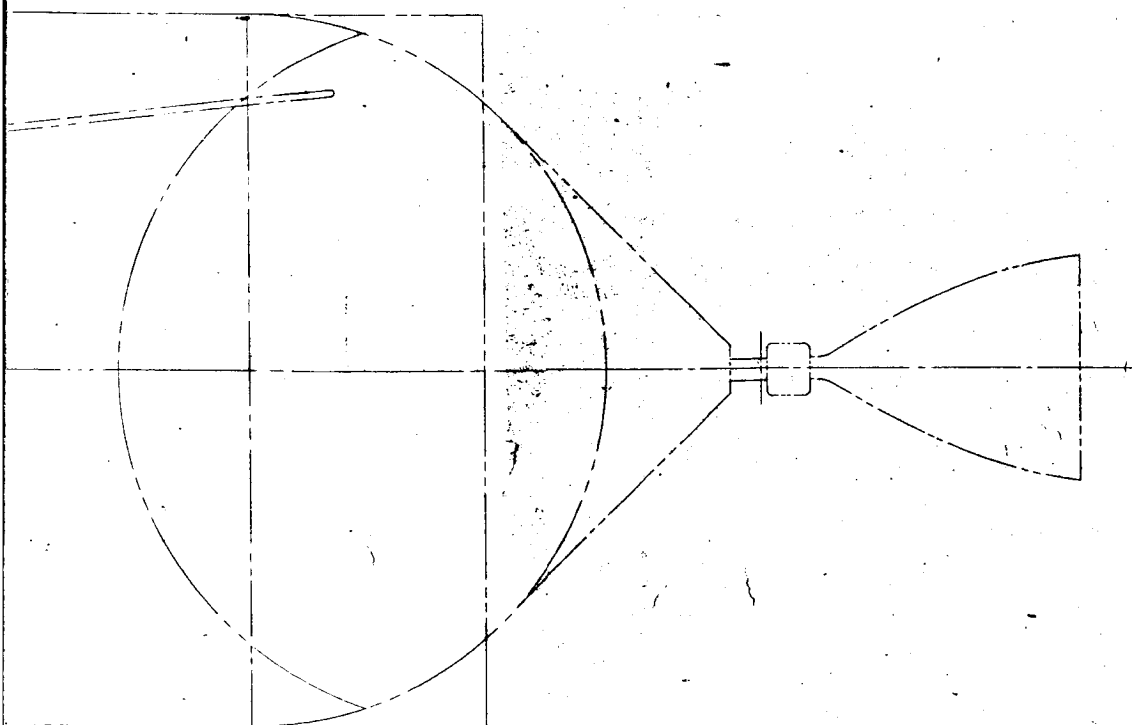
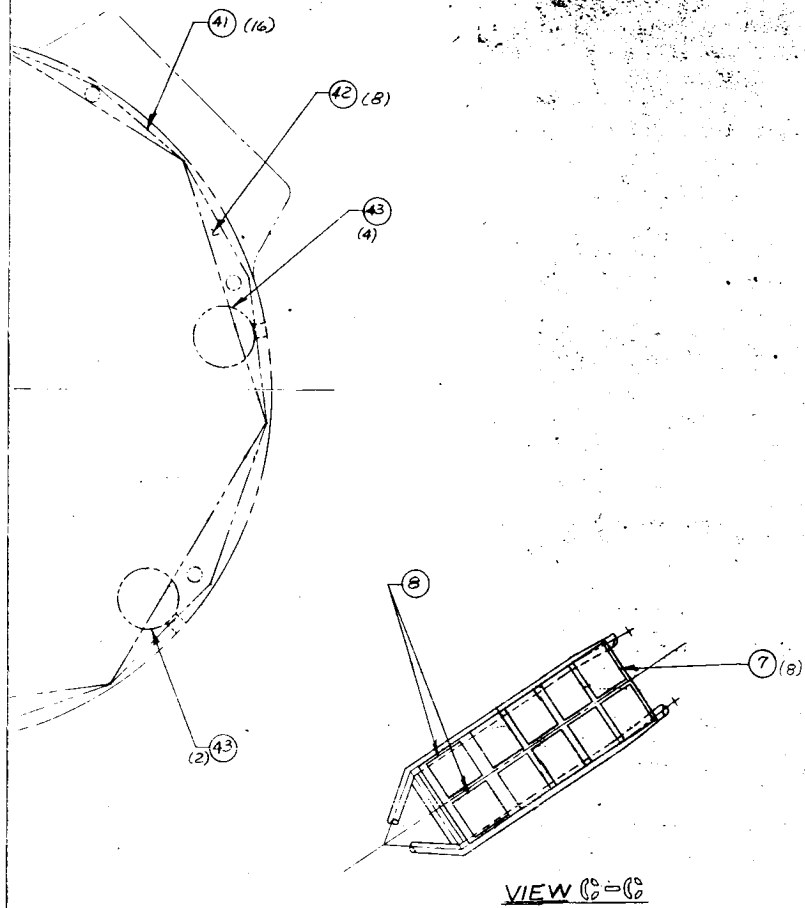
VIEW 13-13 AM TUNNEL INTERIOR STRETCH OUT
FOR COMPONENTS ON AM OUTSIDE OF
TUNNEL, SEE DRAWING OF AM IN MCDONNELL
REPORT NO. E539



SECTION 13-13



1-RESERVED
F.C.P. (49)



ITEM NO.	EXP NO.	COMPONENT
1	MA54	RESERVED FOR SOLAR SHIELDS EXP.
2	ADD ON	SOLAR ARRAY (740 FT ²)
3		PLENUM COVER (8)
4		THERMAL CONTROL SLEEVE (16)
5		ECS PACKAGE COVER
6		HELIUM SPHERE (6)
7	SUB SYST	BATTERY PACKAGE (17)
8	ADD ON	INVERTER (2)
9		DATA MANAGEMENT - CONSISTS OF THE FOLLOWING: COMMAND RELAY MATRIX DISCRETE MULTIPLEXER TIMING & AUDIO MIXER CSM RECORDER VIDEO SWITCH CSM PCM
10		EVA UMBILICAL & 10' TRANSITION UMBILICAL STOWAGE
11		VENTILATION DUCT (2)
12		FAN ASSY
13		AIRLOCK HATCH (STOWED)
14		DEBRIS GUARD (2)
15		EQUALIZATION VALVE
16		TUNNEL VENT VALVE
17		TANK
18		ECS CANISTER
19		SOLIDS TRAP INLET & COMPRESSOR
20		POLYETHYLENE DUCT
21		SIB LIGHT ASSY (PORTABLE) & EXTENSION STOWAGE
22		NET HELMET RETAINER (2)
23		ASTRONAUT SUIT STOWAGE (2)
24		EGRESS HATCH
25		CHEST PACK (2)
26		HANDRAIL
27		UTILITY LIGHT & EXT CHORD WIRE BUNDLE
28		AFT INST PANEL
29		OXYGEN VENT
30		CENTER INST PANEL AIRLOCK CONTROL
31		HHMU & SUPPLY BOTTLE SPACE TOOL & REPAIR KIT STOWAGE
32		AIRLOCK PRESSURIZATION VALVE (2)
33		HANDLE & GEARBOX ASSY
34		EXTRA STOWAGE SPACE (2)
35		LIGHT ASSY (12)
36		FWD INST PANEL
37		INST PANEL
38		CAMERA EQUIPMENT STOWAGE
39		FOOD, PERSONAL HYGIENE & WASTE MGMT HARDWARE
40		ELECTRICAL DISTRIBUTION SYSTEM
41		MOLECULAR SIEVE
42		TRACE GAS CONTROL
43		OXYGEN SUPPLY TANK (2)
44		NITROGEN SUPPLY TANK (2)

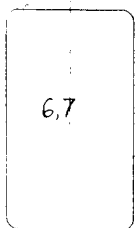
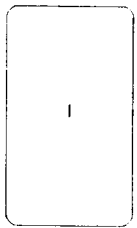
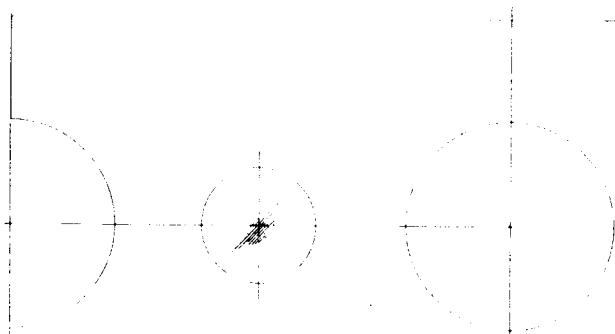
REPORT NO. 0-8002
DATE 1 MAR 1967
PAGE 39

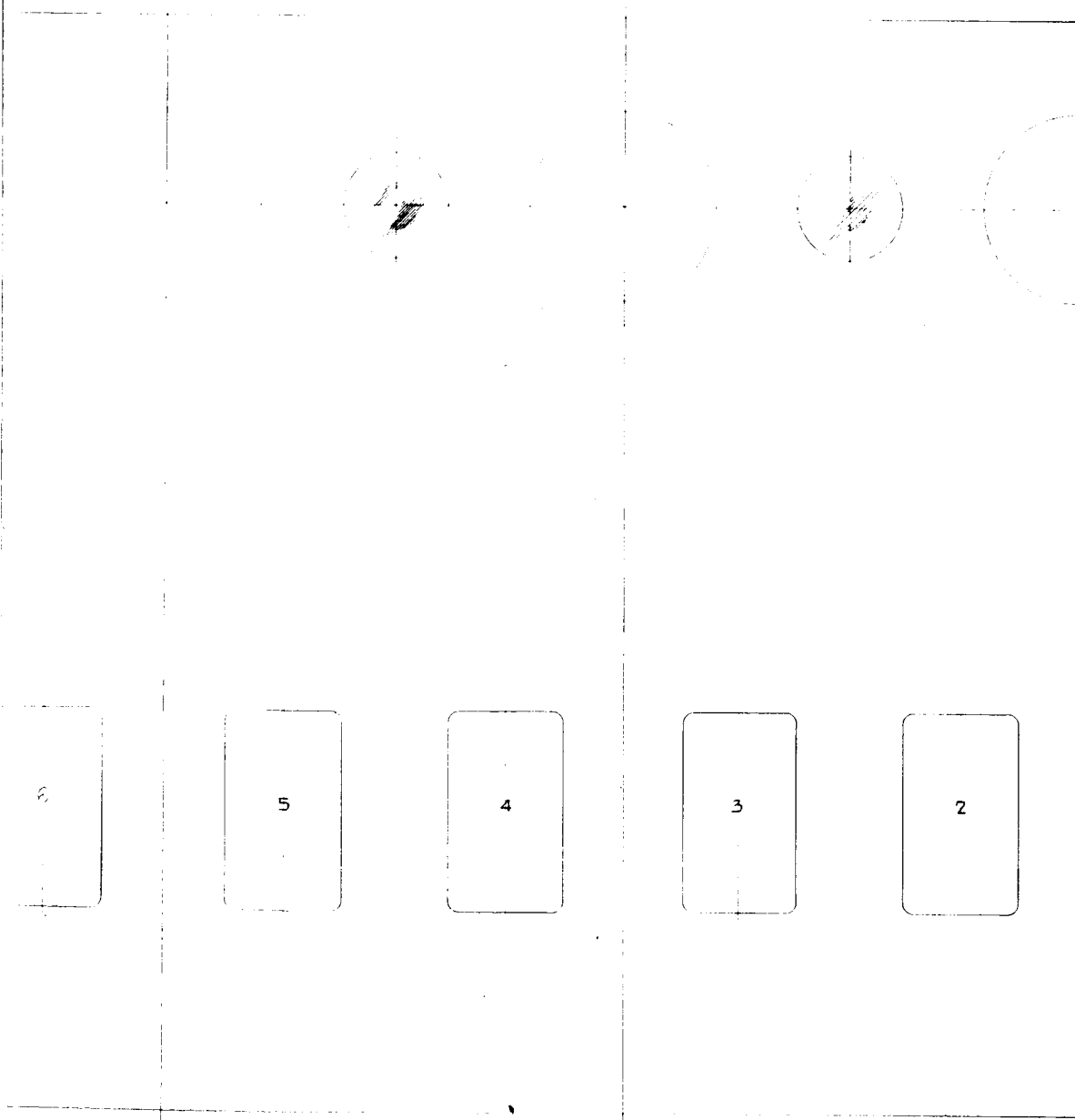
NOTES:

1. PRELAUNCH CREW QUARTER PROVISIONS IN THE SIB TO BE SUPPLIED.

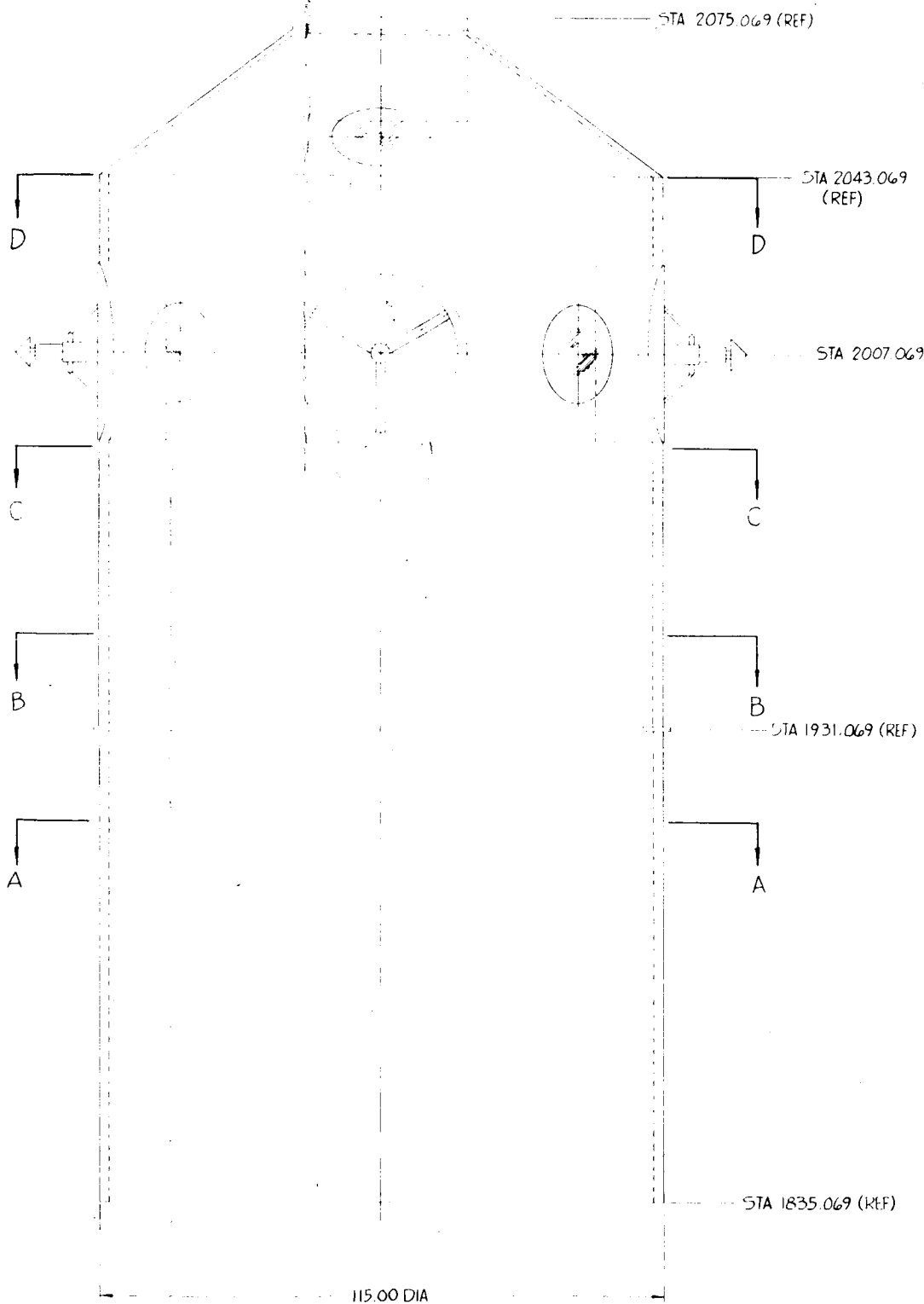
FIG. 63-2

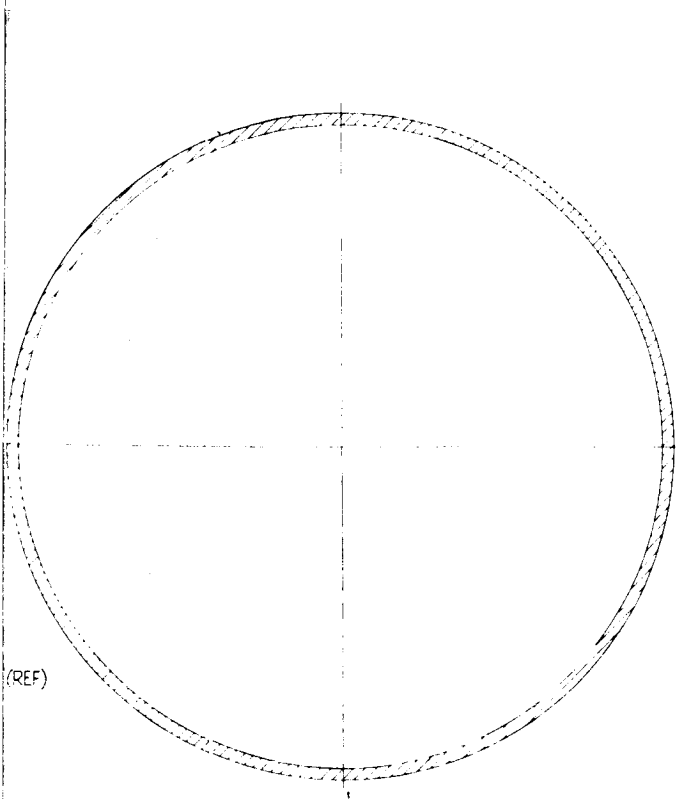
MARTIN MARIETTA CORPORATION
GENERAL CONTRACTOR
NASA / AMT
FLIGHT 40 MISS
30517 1072





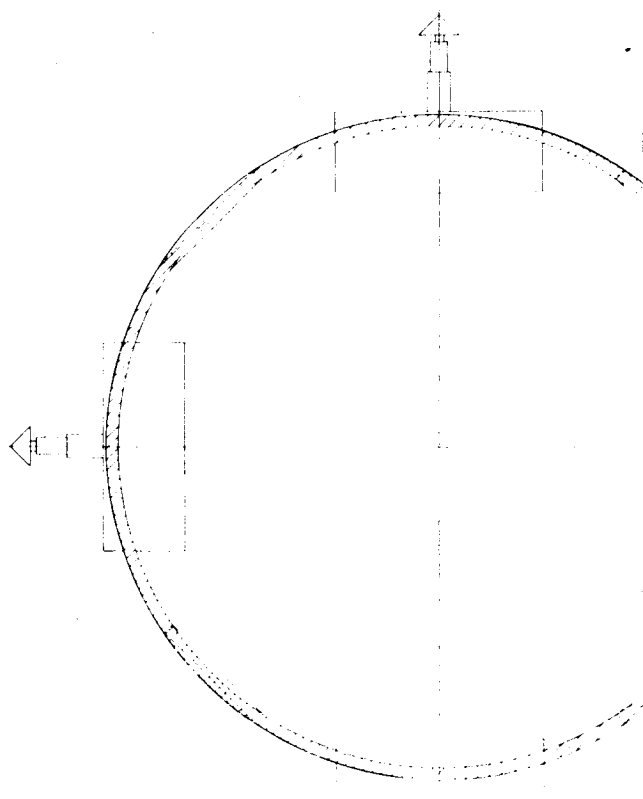
IPED LENGTH OF INSIDE MDA



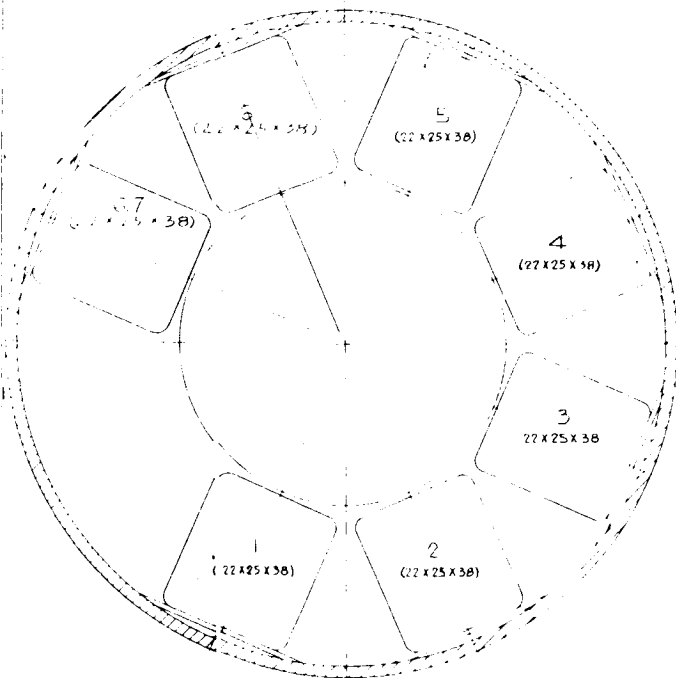


(REF)

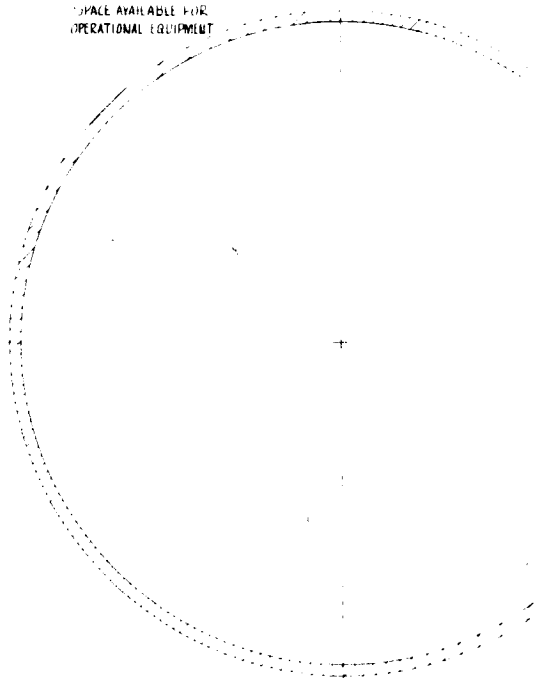
SECTION B-B
SPACE AVAILABLE FOR
OPERATIONAL EQUIPMENT



SECTION D-D
SPACE AVAILABLE FOR
OPERATIONAL EQUIPMENT



SECTION A-A
UNUSED SPACE AVAILABLE
FOR OPERATIONAL EQUIPMENT

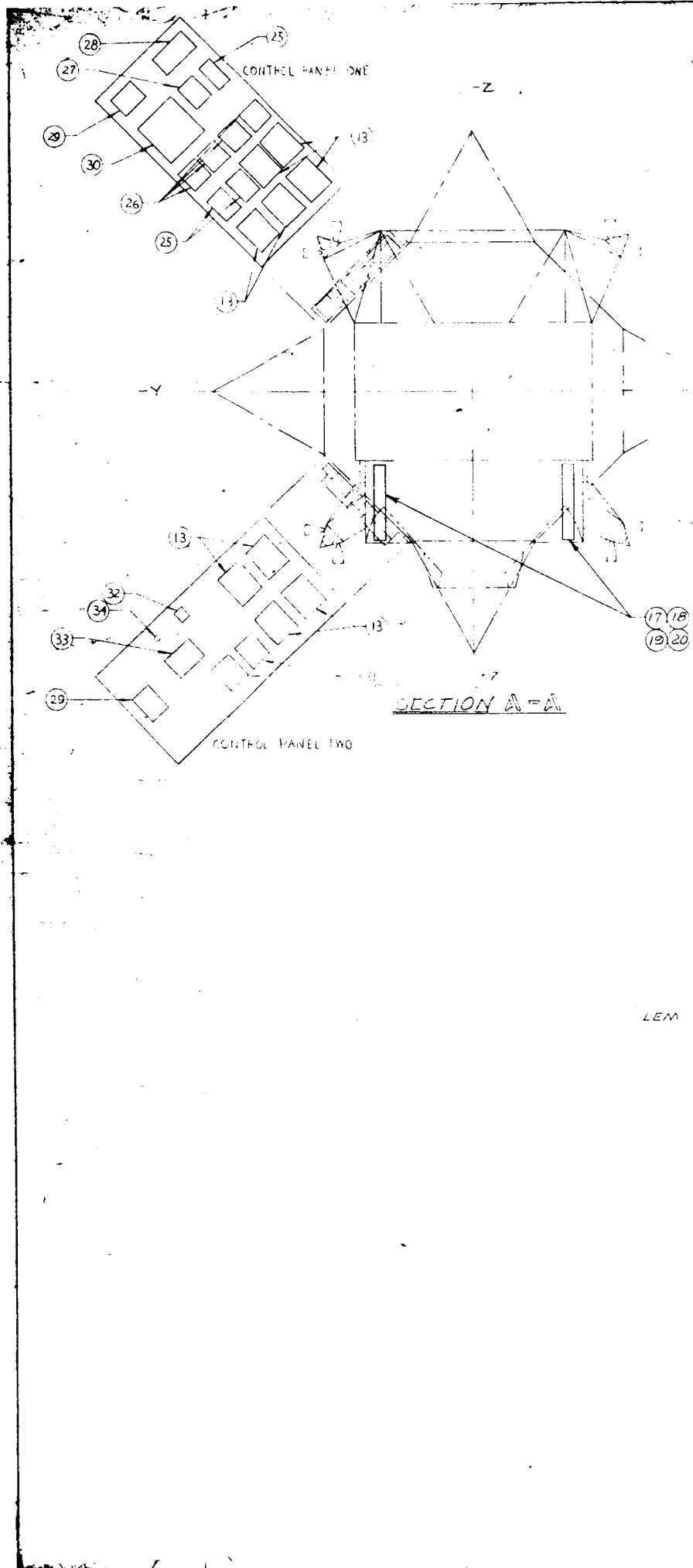


SECTION C-C
SPACE AVAILABLE FOR
OPERATIONAL EQUIPMENT

			REPORT <u>ED0002-59</u>
			DATE <u>29 MARCH 1967</u>
			PAGE <u>6-90</u>
ITEM NO.	EXPERIMENT NO.	COMPONENT	
1	MSFC-6	CAMERA	
		LAMP	
		TEST CHAMBER	
		TAPE RECORDER	
	T007	PORTABLE CRITICAL TASK TESTER	
2	MSFC-43	TEST CELL HOUSING & THERMOSTAT	
		TELESCOPE	
		LIGHT SOURCE	
		POLAROID CAMERA	
		FILM STORAGE	
	T005	EXTERNAL RADIATOR	
		SHROUDED RADIATOR	
		OBSERVATION RACK	
		MOVIE CAMERA	
3	T014	ORBITAL HORIZON DEFINITION	
4	MSFC-54	BEHAVIOR OF PARTICULATE MATERIAL	
5		BIOMEDICAL LAB (EARLY VERSION)	
6	ADD ON	FOOD, PERSONAL HYGIENE & WASTE MANAGEMENT HARDWARE	
7	ADD ON	BAR TRACKER SYSTEM	

FIG 6.3-3

MARTIN MARINETTA CORPORATION
GENERAL CONFIGURATION
MSFC / AM / OMB
FIGURE NO. <u>ML 1072</u>
38157 <u>ML 1072</u>



(14)
(DEPLOYED)

(14)
(STOWED)

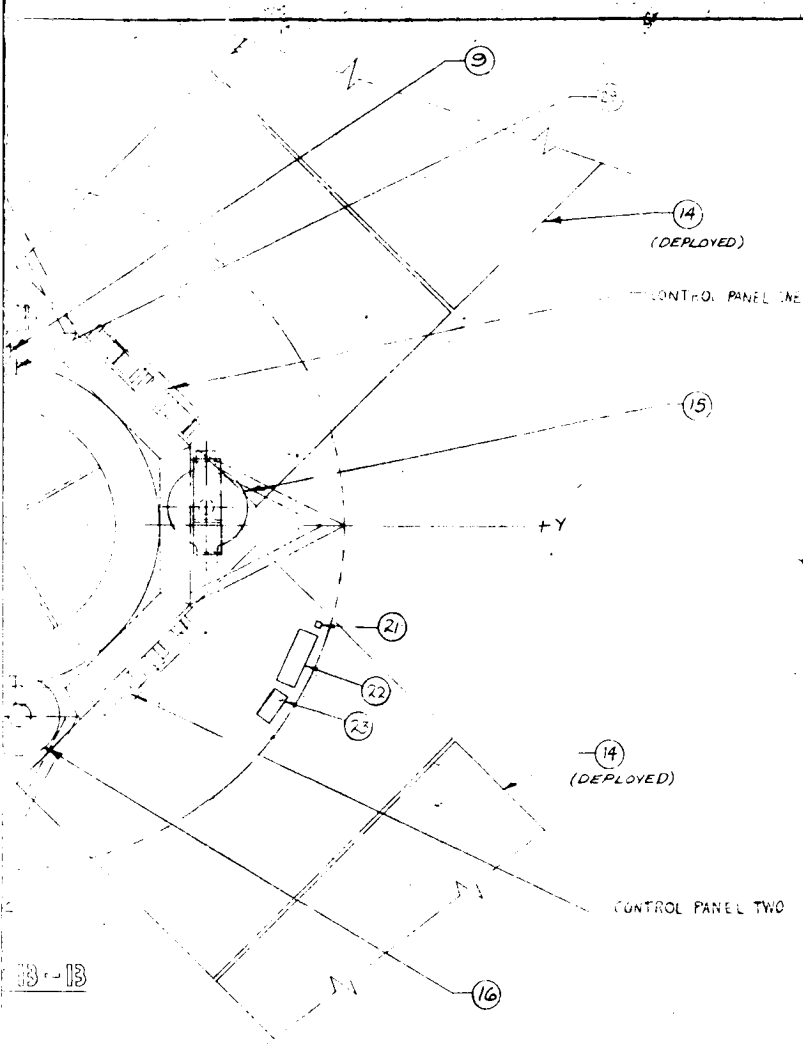
ATM/RACK

SECTION

ATM
RACK

S IV B

(13)
(5-N.S.)
(4-N.S.)



13-13

ED0002-59
29 MARCH 1967
6-91

ITEM NO	EXP NO	COMPONENT
1		
2		
3		NUMBERS NOT IN USE
4		
5		
6		
7	ATM-E	APOLLO TELESCOPE MOUNT EXP. HOUSING INCLUDES: 5052 WHITE LIGHT CORONOGRAPH CAMERA, ETC. 5053A UV CORONAL SPECTROGRAPHS CAMERA, ETC. 5053B UV SPECTROGRAPH CAMERA, ETC. 5054 X-RAY SPECTROGRAPHIC TELESCOPE CAMERA, ETC. 5055A UV SPECTROMETER CAMERA, ETC. 5055B UV SPECTROHELIOMETER CAMERA, ETC. 5055C UV SPECTROMETER - H _α TELESCOPE ETC. 5056 X-RAY TELESCOPE, ETC. MFC H _α TELESCOPE, ETC.
8	SUB SYST ADD ON	VHF/UHF ANTENNA
9		S BAND OMNI ANTENNA
10		LOX TANK
11		WATER TANK (APOLLO DESCENT STAGE)
12		WATER NOT USED
13		BATTERY (3)
14		SOLAR ARRAY (4)
15		CONTROL MOMENT GYRO (3)
16	SUB SYST ADD ON	EGS WATER TANK
17		DISPLAY & CONTROL PANELS IN LEM TO SUPPORT EXP. ARE AS FOLLOWS MFC H _α TELESCOPE PANEL 5052 WHITE LIGHT CORONOGRAPH PANEL 5053A UV CORONAL SPECTROGRAPHS PANEL 5053B UV SPECTROGRAPH PANEL 5054 X-RAY SPECTROGRAPHIC TELESCOPE PANEL 5055A UV SPECTROMETER PANEL 5055B UV SPECTROHELIOMETER PANEL 5055C UV SPECTROMETER - H _α TELESCOPE PANEL 5056 X-RAY TELESCOPE PANEL 18 SUB SYST ADD ON COMMUNICATION DISPLAY & CONTROL PANEL 19 LIFE SUPPORT DISPLAY & CONTROL PANEL 20 GUIDANCE & CONTROL DISPLAY & CONTROL PANEL 21 VIDEO SWITCH 22 ASAP RECORDER 23 MOD 410 CONTROL PANEL ONE 24 BATTERIES (5) 25 MODEL 270 MULTIFLEXER 26 MULTI 410 MULTIFLEXER 27 PCM-301 28 COMMAND RECORDER 29 MEASURING RACK 30 ASAP RECORDER CONTROL PANEL TWO 31 BATTERIES (4) 32 VHF/UHF TRANSMITTER 33 UHF RECEIVER 34 VHF/UHF MULTIFLEXER ANTENNA SWITCH

NOTE:

1. CONTROL PANELS ONE AND TWO DO NOT APPEAR ON PROFILE VIEW

FIG 6.3-4

MARTIN MARIETTA CORPORATION	
GENERAL CONFIGURATION	
LEM / ATM / RACK	
FLIGHT #11	MISSION #A5210
32597	AMP-1076

7. AAP MISSIONS 17/18 AND 36

7.1 Mission Plan

7.1.1 The combined mission will utilize AAP vehicles 17, 18, and 36. Flight 17 and 18 will place payloads in a 19,350 n. mi. synchronous earth orbit at an inclination of 28.9 degrees. Flight 36 will reactivate and operate the flight 17/18 OWS-3. The mission objectives and general mission profile are given in the General DRMD, Document ED-2001.

7.2 Configuration

7.2.1 Flight 17 consists of the vehicle 513 (Saturn V) with a payload of an LCSM, AM, and MDA. The spent S-IVB stage will be reactivated in orbit and become a part of the orbiting cluster as OWS-3. The AM and S-IVB OWS-3 are described in paragraph 4.1.7. The LCSM is described in paragraph 4.1.2. The MDA is described in paragraph 4.1.9. Figure 7.3.1 illustrates the proposed arrangement for living quarters, laboratory, and storage facilities. Tables 7.4-1 thru 7.4-3 provide a weight summary for the flight.

7.2.2 Flight 18 will be launch vehicle 514 (Saturn V) with a payload of an LCSM and a LM/ATM. The LCSM is described in paragraph 4.1.2 and the LM/ATM is the rack described in paragraph 4.1.6 with the ATM experiments, auxiliary equipment and supplies attached. Tables 7.4-4 thru 7.4-6 provide a weight summary for the flight and Figure 7.3.2 shows a proposed arrangement.

7.2.3 Flight 36 will be launch vehicle 522 (Saturn V) with a payload of an LCSM, LM/ATM and resupply provisions. The LCSM is described in paragraph 4.1.2. The LM/ATM is described in paragraph 7.3.2. Tables 7.4-7 thru 7.4-9 provide a weight summary for the flight and Figure 7.3.3 shows a proposed arrangement.

7.3 Ground Rules, Synchronous Orbit Mission 17/18/36 - The following ground rules were used to perform this mission feasibility analysis:

7.3.1 Saturn/Apollo standard hardware considered for synchronous flights will not be modified beyond the point which will allow a 90 day turn-around to the basic Apollo carrier configuration. Any modifications will use flight-rated and man-rated components.

FD-2002-59
29 March 1967

7.3.2 Flight 17 and 18 on-orbit hardware will require active storage or reactivation provisions for reuse during Flight 36. There are no barbecue requirements for the storage mode.

7.3.3 OWS-3 (S-IVB spent stage) will provide the crew with a radiation shelter and house the waste management, personal hygiene, exercise, medical, and recreational equipment for the mission. No experiment will be conducted or housed in the workshop that would adversely affect full duration crew inhabitation if a single mode failure occurs.

7.3.4 The LCSM will provide emergency living quarters (shirtsleeve conditions), and supplies for crew use (three men). The LM will provide shirtsleeve working accommodations for a maximum of two men.

7.3.5 A 30-day supply of food, LiOH, and other crew expendables will be carried by the LCSM, MDA and AM for routine use in the workshop. Environmental control for the workshop shall be provided by the AM system. Flight 36 will require a 45 day supply of life support provisions and commodities.

7.3.6 The AM environmental control system will supply the LM for the complete mission through the MDA. For any emergency operations (CSM/LM docked together), the CM shall provide environmental control for the LM.

7.3.7 Sector 1 of the Service Module (SM) or the Instrument Unit (IU) will not be considered as a carrier for experiments.

7.3.8 Experiment return weight and volume for the Command Module (CM) will be constrained to a maximum of 1066 pounds and 38.25 cubic feet.

7.3.9 During all mission phases, the three astronauts shall have continuous communication capability with each other.

7.3.10 Housekeeping data transmission shall be limited to 16 hours a day, and recorded at all other times for later dump. No ground station network changes will be made for this mission.

7.3.11 The VHF band (225 to 260 MHz) will be available for AAP missions. Experiments will provide their own signal conditioning. Onboard display of selected experiment parameters will be available to the astronauts.

ED-2002-59
29 March 1967

7.3.12 The LCSM control system and CMG on the ATM rack will provide on-orbit stabilization. All translation and orbital maneuvering capability, after separation from launch vehicle, will be supplied by the LCSM propulsion system.

7.3.13 The electrical power available for experiments will be limited to 28 volts direct-current.

7.3.14 The flight 36 payload will consist of expendables required to reactivate OWS-3 and ATM-D experiments. The reactivated OWS-3 will only be used for crew quarters. ATM-D is assumed to be identical to ATM-A.

7.3.15 Subsystem requirements for the synchronous orbit missions will be based on the following operational periods:

Flight 17 -- LCSM for 7 days; LCSM, AM, OWS-3, and MDA for 30 days.

Flight 18 -- LCSM for 7 days; LCSM, AM, OWS-3, MDA and LM/ATM for 30 days.

Flight 36 -- LCSM for 7 days; LCSM, AM, OWS-3, MDA and LM/ATM for 45 days.

7.4 Experiments - The experiments in Tables 7.4-1 thru 7.4-3 were grouped for the flights utilizing the NASA Proposal Guidelines (7 March 1967).

Experiment T012, as presently conceived, cannot be accommodated on the mission because of size and operating constraints and has been deleted for this study. Several experiments, in addition to the NASA list, have been added to the mission. These experiments are compatible with the mission experiment objectives.

Experiment requirements were tabulated and used to assess the capability of the mission systems to fulfill the total mission requirements.

7.5 Analysis Results - The capabilities of the mission carriers and their subsystems were assessed and compared with the mission operational and experiment requirements. The result of this comparison resulted in capability/requirement mismatches which were resolved, for this study, by provision of system changes, either addition or deletion. The following paragraphs summarize the major mission systems analysis.

7.5.1 Electrical Power

7.5.1.1 Electrical power requirements on flight 17 for the LCSM 7 day operation and the subsequent on-orbit housekeeping and experiment operations are summarized below:

<u>LCSM for 7 days</u>	-- Energy 110 KWH, peak 1.85 KW
<u>Operational Housekeeping</u>	-- Energy 1380 KWH, peak 4.13 KW
<u>Experiments</u>	-- Energy 14 KWH, peak 0.22 KW

The baseline LCSM electrical power systems provide a total power energy capability of 115 KWH, peak 3.3 KW, which is in excess of LCSM requirements by 5 KWH energy, 1.45 KW peak.

AM power for operational housekeeping and experiments is not available, and an AM solar array (740 ft²) coupled with batteries similar to that discussed for AAP flight 2 is required to provide flight 17 power requirements of 1394 KWH (1960 W_a) energy, 4.35 KW peak.

7.5.1.2 Electrical power requirements on flight 18 for the LCSM 7 day operation and OWS housekeeping and experiment operations are summarized below:

<u>LCSM for 7 days</u>	-- Energy 110 KWH, peak 1.85 KW
<u>Operational Housekeeping</u>	-- Energy 1380 KWH, peak 4.13 KW
<u>Experiments</u>	-- Energy 1.29 KWH, peak 0.004 KW

The baseline LCSM has an excess power capability for the 7 day operation requirement (Ref. Paragraph 7.5.1.1) The housekeeping and experiment power will be provided by the flight 17 solar array. The AM solar array from flight 17 will provide 1960 W_a, 4.35 KW peak during flight 18 which will satisfy the power requirements of flight 18.

The flight 18 LM/ATM has the following power requirements:

<u>Housekeeping</u>	-- Energy 885 KWA, peak 1.98 KW
<u>Experiments</u>	-- Energy 755 KWA, peak 0.27 KW

A battery and solar array system similar to that defined for flight 4 will provide the capability. The size of flight 18 solar array could be 18% smaller and the battery supply 40% smaller than that defined for flight 4.

7.5.1.3 Electrical power requirements on flight 36 for the XCSM 7 day operation, and the OWS housekeeping and experiment operations are summarized below:

<u>XCSM for 7 Days</u>	-- Energy 110 KWH, peak 1.85 KW
<u>Operational Housekeeping</u>	-- Energy 2100 KWH, peak 4.13 KW
<u>Experiments</u>	-- Energy 0, peak 0

The baseline LCSM has an excess power capability for the 7 day operation (Ref. paragraph 7.5.1.1). The flight 17 solar array can provide the on-orbit operational flight 36 power requirement of 2100 KWH (1940 W_g), peak 4.13 KW. Planned usage of a solar array that has previously been deployed at synchronous orbit altitudes for over a year could present a problem. This problem is discussed in paragraph 7.6.

Flight 36 LM/ATM has the following electrical power requirements:

<u>Housekeeping</u>	-- Energy 1330 KWH, peak 1.98 KW
<u>Experiments</u>	-- Energy 33 KWH, peak 0.23 KW

A battery and solar array system similar to that defined for flight 4 can provide the capability. The size of flight 26 solar array could be 50% smaller and the battery supply 40% smaller.

7.5.2 Thermal Control Systems - No significant mismatches were identified for the mission thermal control systems as presently identified, in the level of analysis performed in this study. A summary of the mission requirements/capabilities is given as follows by carrier element. Since ATM thermal control system capability is not defined, the itemized mismatch is not considered to be significant in this study.

CARRIER (FLIGHT)	CAPABILITY (KWH)	REQUIREMENT (KWH)
LCSM (17)	1740	706
AM (17)	823	218
OWS (17)	635	127
MDA (17)	Not Defined (see AM)	20
LCSM (18)	1740	706
LM/ATM/RACK (18)	*120	1664
LCSM (36)	2574	785
LM/ATM/RACK (36)	*120	937
* ATM system capability not defined - mismatch assumed not to be a carrier problem.		

7.5.3 Guidance and Control (G&C)

7.5.3.1 G&C for Flight 17 - The identified experiments on this flight that require the use of the G&C system are M438, S022, S023, S039. These are compatible with the capabilities of the existing system. Additional experiments which probably impose attitude constraints but for which information is not presently available are as follows: Charged Particle Spectrometer, Earth Albedo Measurements, Radiation Measurement, Libration Region Photography, Measurement of Zodiacal Light from Earth Orbit and Gegenshein and Zodiacal Lights. It is assumed that the requirements imposed by these experiments will be within the capabilities of the existing system and that no add-ons will be required.

7.5.3.2 G&C for Flight 18 - The experiments that require the G&C system on flight 18 are M430, M436, M446, and the ATM experiments. The first two experiments are within the capabilities of the existing G&C system.

Experiment M446, Laser Communication Satellite, requires attitude hold of $.5^{\circ}$ in pitch, roll and yaw for 2 hours. This requirement is marginal for the existing system which has a limit cycle deadband of 0.5° . It is assumed that for the short duration experiment periods, other error sources will be minimal and the necessary adjustments will be made in the experiment tolerance so that it may be performed with the existing system.

Requirements for the ATM experiments are met by the separate pointing control system utilizing CMGs and a gimballed platform. This system is contained in the ATM Rack baseline configuration.

Existing LCSM/LM systems cannot provide the pointing accuracy required by the Resonance Scattering experiment. Furthermore, it does not appear that modification or add-on systems can satisfy the experiment. The problem is resolving the earth's horizon or some emission line in the atmosphere to an accuracy of 1.6 minutes of arc. The best existing sensors provide accuracies of at best 0.1 degrees (6 minutes of arc).

Information is not presently available on the following experiments: Radiation Measurement, Libration Region Photography. It is assumed that requirements arising from these experiments will be within the capabilities of the existing system.

7.5.3.3 G&C for Flight 36 - Experiments presently identified for this flight are LM/ATM experiments with pointing and stabilization furnished by the Pointing Control System included in the ATM Rack baseline configuration. No other add-ons are required.

7.5.4 Propulsion and Reaction Control Systems

7.5.4.1 Comparison of the RCS propellant requirement estimates and carrier capabilities for these synchronous orbit flights reveals no significant discrepancy. What appears to be a significant mission problem with RCS equipment life time is discussed in section 7.6 of this report.

7.5.4.2 The remainder of the propulsion system appears to be adequate for the mission except for system lifetime considerations (Ref. section 7.6).

7.5.5 Environmental Control and Life Support - Numerous deficiencies in system capabilities were identified and resolved by the addition of commodity add-ons, as reflected in Table 7.5.

7.5.6 Data Management - The data management requirements and capabilities for the mission were assessed and are summarized as follows:

Capability (Requirement)	PCM Channels		FM Channels	Recorder Channels			Commands
	High	Low		Anal	Digi	Video	
LCSM 17	44 (28)	633 (356)	3 (0)	3 (1)	1 (1)	1 (0)	64 (10)
AM/MDA/OWS-17	47 (41)	127 (117)	0 (0)	0 (1)	2 (1)	0 (0)	64 (24)
LCSM 18/36	57 (61)	820 (357)	0 (0)	0 (1)	1 (2)	0 (1)	112 (-)
AM/MDA/OWS/- 18/36 ATM RACK	44 (28)	633 (354)	3 (0)	3 (1)	1 (1)	1 (0)	64 (10)

The data management mismatch can be resolved by addition of the add-ons identified in Table 7.5.

The flight 17 AM will require addition of a video recorder and a video switch to facilitate data routing.

Flights 18 and 36 - ATM Rack - The experiment commands can be provided by addition of a model 270 multiplexer.

7.5.7 Communications - The communications incompatibilities implied by the data management tabulation (Ref. paragraph 7.5.6) were solved by selection of the add-ons identified in Table 7.5.

Flight 17 - The received signal strength and transmitter power measurements from the LM relay experiment will be handled by the AM PCM system. The voice and 1.6 KBPS PCM signals from this experiment will be handled by the AM PCM system. The voice and 1.6 KBPS PCM signals from this experiment will be received in the LCSM.

Note: A set of unified S-band equipment is carried for LM relay experiment usage as a part of the experiment.

Flight 18 - LM/ATM - A command relay matrix will be added to the flight 18 ATM Rack to provide command signals required by the Maser Clock experiment.

Flights 18 and 36 - LM/ATM - The LM S-band erectable antenna will be removed because it cannot be used in synchronous orbit. A 70 kilocycle (KC) up-data subcarrier demodulation is added to the S-band communications system to handle the Rack commands. A modification to the LM signal processor is added to detect S-band up-data commands. A video switch in the LM will select one of the two receiver signals for the transmission to the LCSM.

7.5.8 Displays and Controls - The display and control systems for this mission are deficient but not to the point of significantly affecting mission feasibility.

Various controls, consisting mostly of switches, are required for experiments and subsystem add-ons. Additional displays are required for each of the carriers. Tabulation of these as add-ons had not been completed.

7.6 Significant Mission Problem Areas - Mission feasibility was assessed on the basis of the identified system incompatibilities in terms of performance and the ability to withstand or surpass the expected environments. This mission is thought to be generally feasible when the following type problems have been solved.

7.6.1 Solar Array Reusage - The AM solar array from flight 18 may not be suitable over a year later for usage on flight 36 because of possible damage caused by the deep space meteoroid environment while on synchronous orbit.

7.6.2 Space Radiation Exposure - Satellites on synchronous orbit are exposed to all environments ordinarily encountered in low altitude orbits. The synchronous orbit is also high enough to have deep-space environmental problems. This is especially true of the radiation environment. The synchronous orbit is in the outer fringe of the Van Allen belt of trapped radiation. Also, the weak geomagnetic field in this orbit results in almost complete absence of the magnetic shielding effects, which ordinarily protects low altitude satellites from solar flare radiation on near equatorial orbit. During the several years starting in 1968, the sun will be at the maximum of its 11-year cycle of solar flare activity. Therefore, missions on synchronous orbit can expect to encounter both trapped radiation and solar flare.

7.6.3 Meteoroid Hazards - The meteoroid environment on synchronous orbit is less of a problem than space radiation. However, the spacecraft will not have the bulk of the earth as a shield at synchronous altitude. Consequently, the rate of meteoroid impact on the spacecraft will be about double the rate at low altitude.

7.6.4 Weight and Volume - The placing of the desired carrier payloads into the mission orbit is not presently a mission problem. Volume is not a problem except as concerns experiment TOL2, Optical Technology. This experiment, as presently conceived, cannot be integrated satisfactorily into an existing mission carrier.

7.6.5 Mission Effectiveness - Maximum usage of mission carriers and systems has not been achieved and much additional performance is available for experiments in most areas.

7.6.6 The capability of existing and add-on systems to meet all synchronous orbit environments and required durations must be evaluated before mission feasibility can be assured. For examples, see paragraphs 7.6.1 thru 7.6.3.

7.6.7 Effects of crew motion on experiment performance must be determined and restraints or motion compensation provisions provided.

7.6.8 Effects of expected mission element contaminants on optical and laser type experiments and upon crew operations must be resolved.

7.6.9 A system (perhaps phase-lock-loop technique) must be developed for obtaining vehicle altitude information beyond present S-band system capability in order that the maser clock experiment can be performed.

7.6.10 The problems of radiation shielding for the spacecraft, crew, film, and food must be resolved. Astronaut protection devices for EVA and assessment of the allowable EVA durations must be provided. The requirements for a radiation level monitoring and alarm system unique for synchronous orbit missions must be approved (Ref. paragraph 7.6.2).

7.6.11 Evaluation and optimization of the orbital inclination and ground station location must be determined.

7.6.12 The determination of the requirement limits for maximum on-orbit vehicle rates must be accomplished and factored into the mission configuration for cause and effect relationships.

TABLE 7.4 -1

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 17

INJECTION CAPABILITY TO INITIAL ORBIT 109947.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU
25700.
8600.
100.
4300.

**TOTAL

38700.

PAYLOAD CAPABILITY AT LAUNCH 71246.

CONFIGURATION LC5M AM/MDA

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT
3860.
35357.
24403.
1138.

PAYLOAD ABOVE 1.0U.

64758.

PAYLOAD MARGIN

6488.

NOTES

CIRCULAR SYNCHRONOUS 19350 N. MI.
INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 7.4 -2

AAP FLIGHT NO. 17

SPACECRAFT CARRIER	LCSM AM/MDA	DESCRIPTION	LCSM	ADD-ONS	MDA	ADD-ONS	AM	ADD-ONS	TOTAL
I		DRY WEIGHT							
		STRUCTURE	9401.	0.	2566.	0.	2484.	0.	0.
		STARILIZATION & CONTROL	226.	0.	0.	0.	0.	0.	0.
		NAVIGATION & GUIDANCE	440.	0.	0.	0.	0.	0.	0.
		CREW PROVISIONS	84.	0.	361.	0.	0.	0.	0.
		ENVIRONMENTAL CONTROL	702.	91.	449.	0.	612.	150.	0.
		DATA MANAGEMENT	480.	0.	0.	0.	0.	37.	0.
		COMMUNICATION	567.	0.	0.	0.	202.	-10.	0.
		ELECTRIC PWR & DISTR	3181.	0.	0.	0.	200.	0.	0.
		PROPULSION	1130.	0.	0.	0.	0.	0.	0.
		RCS	1064.	0.	0.	0.	0.	0.	0.
		RETROCKETS	1080.	0.	0.	0.	0.	0.	0.
		SLA RING	90.	0.	0.	0.	0.	0.	0.
		EARTH LANDING SYSTEM	617.	0.	0.	0.	0.	0.	0.
		CRYOGENIC SUPPLY SYSTEM	0.	0.	0.	0.	0.	0.	0.
		GFE & FURNISHINGS	0.	0.	0.	0.	3898.	0.	0.
		AM/S-IVB FURNISHINGS	0.	0.	0.	0.	500.	0.	0.
		SOLAR ARRAY	0.	0.	0.	0.	189.	0.	0.
		SCIENTIFIC EQUIPMENT	80.	0.	0.	0.	0.	2185.	0.
		GROWTH MSFC	2301.	0.	0.	0.	0.	0.	0.
		TOTAL DRY WEIGHT	21443.	91.	3376.	0.	8085.	2362.	35357.
		**GROSS DRY WEIGHT							
		VARIABLE LOAD							
II		MAIN PROPELLANTS	16866.	0.	0.	0.	0.	0.	0.
		R C PROPELLANTS	2929.	0.	0.	0.	0.	0.	0.
		CREW PROVISIONS	958.	0.	219.	0.	0.	1233.	0.
		ECS & LIFE SUPT	460.	530.	0.	0.	0.	800.	0.
		UNUSABLE SPS	408.	0.	0.	0.	0.	0.	0.
		TOTAL VARIABLE WEIGHT	21621.	530.	219.	0.	0.	2033.	0.
		**GROSS VARIABLE LOAD							
		**GROSS EXPERIMENT WEIGHT							
		TOTAL WEIGHT							
									24403.
									1138.
									60898.

TABLE 7.4-3
EXPERIMENT LIST - AAP FLIGHT #17

Experiment Number	Experiment Title	Location		Weight (Lbs)	
		Launch	Performed	Net	Mounting
M011	Cytogenetic Blood Studies	No In-Flight Requirements		0	0
M022	Red Blood Cell Survival	No In-Flight Requirements		0	0
M438	Navigation Photography	CM	CM	5	4
-----	Charged Particle Spectrometer	AM-OUT	AM-OUT	10	7
S022	Low Z Cosmic Ray	AM-OUT	6' Boom	195	35
S023	High Z Cosmic Ray	AM-OUT	6' Boom	150	31
S039	Day-Night Camera	AM-OUT	AM-OUT	180	34
-----	Earth Albedo Measurement	AM-OUT	AM-OUT	50	18
-----	Radiation Measurement	CM, AM, MDA	CM, AM, MDA, OWS-3	8	6
-----	Thermal Control Surfaces	AM-OUT	AM-OUT	0	0
-----	Libration Region Photography	CM	CM	25	12
③-----	*OWS Habitability Kit	CM, MDA, AM	OWS-3	15	9
③-----	Measurement of Zodiacal Lights from Earth Orbit	CM	CM	4	4
③-----	Gegenschein and Zodiacal Lights	CM	CM	6	5
M430	LEM Relay Experiment	AM	AM	275	41
Total Net Weight - 923 pounds; Total Gross Weight - 1138 pounds.					
* OWS habitability for crew quarters demonstrated on previous flights used here as operational tool.					
③ Experiments in addition to NASA proposal guidelines.					

TABLE 7.4 -4

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 18

INJECTION CAPABILITY TO INITIAL ORBIT 109947.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU
25700.
8600.
100.
4300.

**TOTAL

38700.

PAYLOAD CAPABILITY AT LAUNCH

71246.

CONFIGURATION LC5M LM/ATM

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT
3860.
39019.
23982.
2712.

PAYLOAD ABOVE I.U.

69574.

PAYLOAD MARGIN

1673.

NOTES

CIRCULAR SYNCHRONOUS 19350 N. MI. ORBIT
INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT (POUNDS)

TABLE 7.4 -5

AAP FLIGHT NO. 18

SPACECRAFT
CARRIER

LCSCM

LM/ATM

DESCRIPTION

LCSCM

ADD-ONS

LM

ADD-ONS

ATM RACK

ADD-ONS

TOTAL

I

DRY WEIGHT

STRUCTURE
STABILIZATION & CONTROL
NAVIGATION & GUIDANCE
CREW PROVISIONS
ENVIRONMENTAL CONTROL
DATA MANAGEMENT
COMMUNICATION
ELECTRIC PWR & DISTR
PROPULSION

RCS

RETROROCKETS

SLA RING

EARTH LANDING SYSTEM

SOLAR PANELS

SCIENTIFIC EQUIPMENT

GROWTH MSFC

TOTAL DRY WEIGHT

**GROSS DRY WEIGHT

VARIABLE LOAD

MAIN PROPELLANTS

R C PROPELLANTS

CREW PROVISIONS

ECS & LIFE SUPPORT

UNUSABLE SPS

CYROGENICS

TOTAL VARIABLE WEIGHT

**GROSS VARIABLE LOAD

**GROSS EXPERIMENT WEIGHT

III

TOTAL WEIGHT

9401.	0.	1326.	0.	2250.	688.
226.	0.	87.	67.	0.	0.
440.	0.	289.	0.	0.	1549.
84.	0.	103.	0.	0.	0.
702.	0.	347.	0.	0.	345.
480.	0.	350.	0.	0.	327.
567.	0.	100.	23.	0.	1384.
3181.	0.	213.	0.	0.	2281.
1130.	0.	15.	0.	0.	0.
1064.	0.	386.	266.	0.	0.
1080.	0.	0.	0.	0.	0.
90.	0.	0.	0.	0.	0.
617.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
80.	0.	0.	0.	0.	5150.
2301.	0.	0.	0.	0.	0.
21443.	0.	3216.	30.	0.	0.
			386.	2250.	11724.
					39019.
16866.	0.	0.	0.	0.	0.
2929.	0.	0.	0.	0.	0.
958.	0.	0.	1233.	0.	0.
460.	69.	0.	800.	0.	0.
408.	0.	0.	0.	0.	0.
0.	0.	0.	259.	0.	0.
21621.	69.	0.	2292.	0.	0.
					23982.
					2712.
					65713.

TABLE 4-6
EXPERIMENT LIST - AAP FLIGHT #18

ED-2002-59
29 March 1967

7-16

Experiment Number	Experiment Title	Location		Weight (Lbs)	
		Launch	Performed	Net	Mounting
M011	Cytogenetic Blood Samples	No In-Flight Reqmts		0	0
M022	Red Blood Cell Survival	No In-Flight Reqmts		0	0
M446	Laser Communication Satellite (MSFC 48)	Rack	Rack	300	53
----	Synchronous Orbit Radio Beacon	Rack	Rack	75	22
----	Navigation and Traffic Control Satellite	Rack	Rack & Subsatellite	329	44
----	Radiation Measurements	CM, LM	CM, LM, MDA, AM, OWS-3	0	0
----	Maser Clock Relativity	Rack	Rack	670	60
----	Barium Release	Rack	Space	30	14
----	Solar Burst	Rack	Space	50	18
M438	Navigation Photography	CM-1	CM-2	1	1
----	Libration Region Photography	CM-1	CM-2	0	0
③	Erectable Antenna for Radio Astronomy	Rack	Rack	150	31
----	IR Celestial and Planetary Survey	ATM	ATM	45	17
----	X-Ray Astronomy	ATM	ATM	400	48
ATM C	UV High Dispersion Spectrographs	ATM	ATM	60	20
----	UV Photography Lyman-Alpha Region	ATM	ATM	5	4
----	Visible Photography	ATM	ATM	40	16
Total Net Weight - 2355 pounds; Total Gross Weight - 2712 pounds.					

③ - Experiment in addition to NASA proposal guidelines.

Experiment T012, Optical Technology, was deleted from the experiment grouping (Ref. paragraph 7.4)

TABLE 7.4 -7

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 36

INJECTION CAPABILITY TO INITIAL ORBIT 109947.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

25700.
8600.
100.
4300.

**TOTAL

38700.

PAYLOAD CAPABILITY AT LAUNCH

71246.

CONFIGURATION LCMS LM/ATM

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
39348.
25071.
1992.

PAYLOAD ABOVE I.U.

70271.

PAYLOAD MARGIN

974.

NOTES

CIRCULAR SYNCHRONOUS 19350 N. MI. ORBIT
INCLINATION 28.9 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 7.4 -8

AAP FLIGHT NO. 36

SPACECRAFT LCSCM
CARRIER LM/ATM

DESCRIPTION

LCSCM ADD-ONS LM ADD-ONS ATM RACK ADD-ONS TOTAL

I

DRY WEIGHT
STRUCTURE
STABILIZATION & CONTROL
NAVIGATION & GUIDANCE
CREW PROVISIONS
ENVIRONMENTAL CONTROL
DATA-MANAGEMENT
COMMUNICATION
ELECTRIC PWR & DISTR
PROPULSION
RCS
RETROROCKETS
SLA RING
EARTH LANDING SYSTEM
SOLAR PANELS
SCIENTIFIC EQUIPMENT
GROWTH MSFC

TOTAL DRY WEIGHT
**GROSS DRY WEIGHT
VARIABLE LOAD

II

MAIN PROPELLANTS
R C PROPELLANTS
CREW PROVISIONS
ECS & LIFE SUPT
UNUSABLE SPS
CRYOGENICS

TOTAL VARIABLE WEIGHT
**GROSS VARIABLE LOAD
**GROSS EXPERIMENT WEIGHT

II

TOTAL WEIGHT

9401.	0.	1326.	0.	2250.	688.
226.	0.	87.	0.	0.	0.
440.	0.	289.	0.	0.	1549.
84.	158.	103.	0.	0.	0.
702.	214.	347.	0.	0.	195.
480.	0.	350.	0.	0.	306.
567.	0.	100.	0.	0.	1384.
3181.	0.	213.	0.	0.	2281.
1130.	0.	15.	0.	0.	0.
1064.	0.	386.	0.	0.	0.
1080.	0.	0.	0.	0.	0.
90.	0.	0.	0.	0.	0.
617.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
80.	0.	0.	0.	0.	5150.
2301.	0.	0.	0.	0.	0.
21443.	372.	3730.	0.	2250.	11553.
16866.	0.	0.	0.	0.	0.
2929.	0.	608.	0.	0.	0.
958.	187.	0.	0.	0.	107.
460.	2289.	0.	0.	0.	0.
408.	0.	0.	0.	0.	0.
0.	0.	0.	0.	259.	0.
21621.	2476.	608.	0.	259.	107.

39348.

25071.
1992.

66411.

TABLE 7.4-9
EXPERIMENT LIST - AAP FLIGHT #36

Experiment Number	Experiment Title	Launch	Performed	Net	Mounting
<u>ATM 4</u>					
S054	X-Ray Spectrograph	IM/ATM	IM/ATM	230	38
S055A	UV Spectrometer	IM/ATM	IM/ATM	110	27
S056	X-Ray Telescope	IM/ATM	IM/ATM	270	41
S055B	UV Spectroheliometer	IM/ATM	IM/ATM	110	27
S055C	H α Telescope	IM/ATM	IM/ATM	130	29
S053A	UV Coronal Spectroheliograph	IM/ATM	IM/ATM	300	43
S052	White Light Coronagraph	IM/ATM	IM/ATM	161	32
S053B	UV Spectrographs	IM/ATM	IM/ATM	300	43
Total Net Weight - 1686 pounds; Total Gross Weight - 1992 pounds.					
Notes: See paragraph 7.3.14.					

RECOMMENDED SUBSYSTEM CHANGES

TABLE 7.5-1

CARRIER LCSCM

FLIGHT 17

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT (lb)
Life Personal Support	Add	Excess Capability	Food Personal Hygiene	-2.21 Ft ³	-65
Potable Water	Remove	Mission Requirement not Satisfied by Basic LCSCM	Water Tank (1)	12.55"x17.12"	17
CO ₂ Removal		Excess Capability	LiCH (Charcoal)	N/A	78
				-2.56 Ft ³	-76
Life Support	CARRIER	LCSCM	FLIGHT 18		
Potable Water	Remove	Will not satisfy Req'm't	Potable Water Tank	-(12.55"x12.22")	-28
	Add	Mission Requirement Not Satisfied by Basic LCSCM	Water Tank (1)	15"x32"	47
Personal	Remove	Excess Capability	Water	N/A	137
	Remove	Excess Capability	Cryogenic Oxygen Tank	26"00	-601
		Excess Capability	Feed & Personal Hygiene	-2.56 Ft ³	-76
Life Support	CARRIER	LCSCM	FLIGHT 36		
Potable Water	Add & Remove	Mission Requirement Not Satisfied by Basic LCSCM	Water Tanks (3)	28.4"x32.5"	90
		Will not Satisfy Req'm't	Water	N/A	910
			Potable Water Tank	-(12.55"x12.22")	-28
Supplies	Add	Mission Requirement Not Satisfied by Basic LCSCM	Food Supplies (96 Mar Days)	9.35 Ft ³	202
		Will Not Satisfy Req'm't	Personal Hygiene	5.2 Ft ³	96
Oxygen	Add	Mission Requirement Not Satisfied by Basic LCSCM	Oxygen Tank	4' .5"x94"	1344 (Net)
	Remove	Will Not Satisfy Req'm't	Oxygen Tank	26.3"00	-906

RECOMMENDED SUBSYSTEM CHANGES

TABLE 7.5-2

CARRIER Summary

MISSION 17, 18 and 36

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT (LB)
EVA Support (Flt 17, 18, 36)	Add	PLSS Recharges (AM)	PLSS Batteries PLSS LIOH	TBS TBS	TBS
	Add	Housekeeping and Experiments Require 1394 KWH (AM)	Solar Array NiCd Batteries Inverters Distrib. Sys	740 Ft ² 6.76 Ft ³ 1.69 Ft ³ .46 Ft ³	1350 640 80 115
Data Managmt	Add	Experiment Data Routing in AM (Flt 17)	Video Switch Video Recorder	.49 Ft ³	37
	Add	Commands for Experiments on ATM Rack Flts 18 & 36	Mod 270	.57 Ft ³	21
Communications Flts 18 & 36	Remove	Antenna cannot be used in Syn. Orbit	S-Band Erectable Antenna (LM)	36" x 10"	-10
	Add	Rack Command Sys (LM)	Up-Data Detector/Decoder	6"x10"x18"	22
	Add	To Detect Up-Data Subcarrier	Signal Processor Mod	1" x 2" x 1"	1

RECOMMENDED SUBSYSTEM CHANGES

TABLE 7.5-3

CARRIER AM/MDA

MISSION 17/18/36

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT (#)
Life Support	Add	Need to Fulfill Life Support Requirement	Nitrogen Tanks - 2	26.3" OD	652
			Oxygen Tanks - (1) (1)	41.5" OD x 44" 23" OD	1599
			CO ₂ Trace Gas Removal	20 Ft ³	470
			Water Tanks (3) (1)	28.4" x 32.5" 12.55" OD x 10.22"	1108
			Food Supplies	10 Ft ³	304
			Personal Hygiene	5.3 Ft ³	144
			Note: AM Life Support System Supplies were not Assumed to be Baseline AM/MDA Supplied.		

8.0 MISSION 19/20, 21/22, 23/24

8.1 Mission Plan - Mission 19/20 (or 21/22 or 23/24) is planned as a lunar surface exploration mission. The total manned duration will be approximately 32 days (Flight 19, 21, or 23 for 10 days and Flight 20, 22, or 24 for 22 days) with manned lunar surface operations consuming 14 days maximum. Flights 20, 22, and 24 will be integrated by NASA-MSC.

The General Mission Profile and the Mission Objectives will be as described in the General DRMD, Document ED-2001.

8.2 Configuration

8.2.1 Launch Vehicle - The standard Saturn V launch vehicle will be utilized for all mission flights and will consist of the following major elements:

- S-IC
- S-II
- S-IVB (1 restart)
- Instrument Unit (IU)
- Spacecraft IM Adapter (SIA)
- Launch Escape System (LES)

8.2.2 Spacecraft - The spacecraft for flights 19, 21, and 23 will consist of the Block II CSM and the IM Shelter defined by the ground rules of this report.

The spacecraft for flights 20, 22 and 24 will consist of the Block II CSM, with add-ons, and the IM Taxi as defined by the ground rules of this report. Integration of these flights will be NASA MSC responsibility.

8.2.3 Mission Weight Statements - The weight statements for each shelter flight for the missions are shown in Tables 8.4.1 and 8.4.2. The statements have been prepared, using the mission ground rules, to ascertain the feasibility of mission performance with respect to the desired payload and added subsystems and components which appear necessary to satisfy the mission performance requirements.

8.3 Ground Rules - The following ground rules were used in assessing the capability of the mission vehicles with respect to the mission operational and experiment requirements:

- a. The flight 19, 21 or 23 will be inflight a maximum of 10 days.
- b. The flight 20, 22 or 24 CSM will be inflight a maximum of 22 days.
- c. The data presented in the following references will be utilized as the mission ground rules, except as amended by section 8.3, Ground Rules of the report.

- 1) AAP Preliminary Definition Study and Utilization of IM, Contract NAS 9-4983, Addendum II Final Report, Volume II - Program Report (29 July 1966).
- 2) AAP Preliminary Definition Study of Utilization of IM, Contract NAS 9-4983, Addendum II, Final Report, Volume I - Technical Report Sections 2 and 3 (29 July 1966).
- 3) Volume V, Shelter Design Analysis Summary (Confidential), Grumman, AFS IM Phase B Definition Study (1965).
- 4) Volume VI, Taxi Design Analysis Summary (Confidential), Grumman, AFS IM Phase B Definition Study (1965).
- 5) Saturn/Apollo Applications Program, Lunar Scientific Missions (14 day, 2-man explorations) Research Projects Laboratory, MSFC, August 1966.

- d. The manned Lunar Surface Exploration portion of the mission will be performed during the lunar day.
- e. The lunar landing location will be equatorial.
- f. Subsystem add-on will be effected in conformance with "Manned Spacecraft Criteria and Standards", NASA-MSC.
- g. Lunar Surface Mission equipment will be sized and designed for the lunar environments presented in M-DE8020.008B, SE 015-001-1, "Natural Environment and Physical Standards for the Apollo Program", NASA, April 1965.

- h. The S-IVB stage for each flight will have one restart capability.
- i. The lunar surface crew will consist of two men. Lunar surface manned operating time will be 14 days minimum.
- j. The Taxi or the Shelter will not exceed a gross weight at lunar landing of 16,300 pounds.
- k. The IM Taxi ascent stage experiment return weight at lunar launch will not exceed 250 pounds.
- l. EVA operations on the lunar surface will be limited to six continuous hours per day.
- m. Personal equipment required for EVA will not be provided as experiment equipment and will be considered as operational or add-on payload.
- n. The experimental payload for these missions will be as discussed in section 8.4 of this report.
- o. The shelter RTG will be activated by EVA on lunar orbit.
- p. The soft suits, PLSS, and other EVA equipment carried by the CSM which accompanies the Taxi will be transferred to the Taxi, on lunar orbit, and utilized for initial manned shelter activation.
- q. The Shelter fuel cells produce 0.9 pounds of H_2O per KWH of energy.
- r. All power for manned shelter operation will be obtained from the fuel cells.
- s. Each shelter crewman will perform lunar surface EVA.
- t. The following rates will be used for computation of requirements against the mission carriers.
 - 1) Water consumption
 - Metabolic - 6.6 lb/man/day
 - EVA (PLSS) - 2.0 lb/hr

2) Water production

Fuel Cells - 0.9 lb/KWH

3) Oxygen consumption

Cabin leakage and airlock repressurization -
5 lb/day

Metabolic - 2.0 lb/man/day

EVA (PLSS) - 0.25 lb/hr

Power Production (FCA) - 0.8 lb/KWH

8.4 Experiments - The experiments considered for these missions are listed by NASA number, title, and flight locations. These experiments are grouped to satisfy the mission objectives specified by NASA.

8.4.1 CSM (Flights 19, 21, and 23) - No experiments presently considered.

8.4.2 CSM (Flights 20, 22, and 24) - No experiments presently considered.

8.4.3 LM Taxi (Flights 20, 22, and 24)

M011 - Cytogenic Blood Studies

M022 - Red Blood Cell Survival

- - Laser Altimeter

8.4.4 LM Shelter (Flights 19, 21, and 23) - The shelter experiments for this analysis are shown in Table 8.4-3. This listing will be applicable for each shelter flight. Certain additions and deletions to the NASA proposal guidance experiment lists were made, to more effectively utilize payload margins, by deleting redundancy and adding needed experiment equipment.

8.5 Analysis Results - The mission profile, ground rules, experiment list and reference documents were used to perform a cursory study of the feasibility for performing the 14-day IM Shelter/Taxi lunar exploration missions as presently conceived. The purpose of the study was to ascertain, at a gross level, what major significant problems will have to be solved in order to successfully perform the missions. The results of this study

are presented in this report section, in terms of existing system capability, assessed system requirements, capability and requirement mismatch, and suggested manner or method of effecting the mismatch, and suggested manner or method of effecting the mismatch resolution. Only those mission carrier systems where significant mismatch has been identified are illustrated.

8.5.1 CSM (10 day) - Flights 19, 21, and 23 - No significant mismatches of capability versus requirements were identified. A certain amount of excess provision exists and can be removed to provide an increase in the shelter throw weight which does appear to be necessary.

8.5.2 CSM (22 day) - Flights 20, 22, and 24 (Reference Only) - The only significant mismatch identified was in the electrical power capability. An additional 132 KWH of energy is required to provide the increased flight duration capability from 14 days to 22 days (maximum). This mismatch was solved by addition of super-critical oxygen and hydrogen tanks (reference Table 8.5-2).

An additional mismatch was identified in the Life Support System oxygen capability. Additional oxygen is required to provide for mission extension (cabin leakage) - approximately 35 pounds. This oxygen is included in the electrical power supply add-on (reference Table 8.5-2).

8.5.3 IM Taxi - Flights 20, 22, and 24 (Reference only) - No significant mismatches, capability versus requirements, were identified.

8.5.4 IM Shelter - Flight 19, 21, and 23 - Significant mismatches, capability versus requirements, for the Shelter flights occur in the following system areas:

- a. Electrical Power Supply - The IM shelter electrical power capability for the manned shelter phase from the fuel cells is 425 KWH. The total assessed mission requirements for fuel cell power is 678.5 KWH. The additional 253.5 KWH can be obtained by adding sufficient fuel cell reactants (reference Table 8.5-4).
- b. Data Management - The experiments carried by the IM Shelter require a capability for data recording, FM data handling, and a television circuit. The first two requirements can be solved by addition of a portable recording assembly which contains a VCO, data switch,

and a two track video recorder. This portable recorder can be utilized inside or outside of the shelter (ISSM).

The experiment requirement for real time television, ISSM to Shelter, will have to be extensively analyzed before a type system can be suggested (reference Table 8.5-4).

c. Thermal Control - The required heat rejection for the manned shelter phase approximates 486 KWH. The total shelter capability totals 296 KWH. This mismatch was not apparent in the baseline configuration thermal analysis (see Section 8.3c Ground Rules) because a lower baseline electrical load was assumed than that which existed for the electrical load analysis summary. The means of solving the mismatch probably will result in a combination of radiator area increase and water sublimator flow rate increase coupled with the addition of sublimator water. For purposes of this report, the mismatch was solved by the addition of sublimator water only (reference 8.5.4d, Life Support). The additional sublimator water required, using this method, is 648 pounds. The total water allocated for the water sublimators (add-on plus baseline) is 996 pounds.

d. Life Support - Oxygen - Additional life support oxygen is required to support increased EVA activity from that assumed in the baseline configuration (115 hours baseline capability). The following table summarizes the manned phase shelter oxygen requirements, capability, and add-on.

Oxygen requirements:

Fuel Cells - 503 pounds
Metabolic - 56 pounds
Shelter and Airlock Leakage - 70 pounds
EVA (PLSS for 133 hours) - 33 pounds

Total - 662 pounds

Required add-on - 95 pounds

e. Life Support - Water - Additional life support water is required to support the increased EVA activity from that assumed in the baseline configuration. The following table summarizes the preutilization, checkout, and manned phase shelter water requirements, capabilities, and add-ons:

WATER CAPABILITY (BASELINE)

Stored at Launch	-	303 pounds
Chemical Production	-	28 pounds
Metabolic Recovery	-	113 pounds
Fuel Cell Production	-	<u>637</u> pounds
Total		1081 pounds

WATER REQUIRED

Metabolic	-	185 pounds
EVA (PLSS - 132 hours)	-	265 pounds
Sublimation		
Manned Phase	-	996 pounds
Preutilization	-	<u>37</u> pounds
Total		1483 pounds
Required Add-On		401 pounds

f. EVA Support - The Shelter baseline configuration includes one EVA hard suit and accessory components. The EVA activity and report ground rules require a fitted hard suit be available for each Shelter crewman. One EVA hard suit and accessory components are therefore added to the shelter configuration (reference Table 8.5-4, EVA Support).

8.6 Significant Problem Areas - The following paragraphs represent problem areas which appear to be more significant than the normal problems encountered in mission planning and design. These problems are limited to airborne considerations of the spacecraft for these lunar landing missions. An attempt to assess the ground operation and testing problems and procedures was not attempted during this study.

8.6.1 Lunar surface staytime and landing site locations affect the existing Apollo abort criteria for the existing vehicle capability (CSM, Taxi) in terms of ΔV and plane change capability. Exacting tradeoffs must be made for the desirability and methods of increasing IM Taxi EPS and ECS lifetimes for abort contingencies. Changing of the basic Apollo abort criteria to delete requirements for CSM rescue of IM Taxi must be assessed by trading off CSM plane change capability and increased Taxi ascent stage lifetime. The Shelter/Taxi mission lunar landing sites must be determined as quickly as possible so that specific location requirements can be levied against the missions.

8.6.2 The IM Shelter thermal design must be updated to reflect the increasing manned phase operational requirements.

8.6.3 Cryogenic commodity storage for the Shelter must be re-investigated as to system feasibility per the existing Shelter storage criteria.

8.6.4 Re-evaluation of the Shelter 90-day storage requirement must be accomplished and decreased, if possible, in order to enhance the mission feasibility consistent with present operational objectives.

8.6.5 Radioisotope Thermoelectric Generator (RTG) integration and operation during Shelter storage and manned phase experiment operation must be definitized. This includes usage, thermal isolation from carriers, lunar surface deployment, and abort considerations.

8.6.6 ISSM to Shelter communication and navigational problems must be evaluated and traded off because of the problems inherent in Lunar line-of-sight due to experimental traverse distances. This line-of-sight problem can also adversely affect astronaut travel Taxi to Shelter.

8.6.7 IM Shelter and Taxi command system operation and design must be evaluated and scoped to meet the needs of the presently defined operations.

8.6.8 Stringent assessment of the ability of the Shelter crew to perform the operational and experimental portions of the lunar exploration missions must be made in terms of equipment, equipment life, task timelines, and crew training.

8.6.9 Further optimization of vehicle systems and equipment in terms of weight and volume must be provided so that the presently conceived operations will be accomplished. The Shelter and Taxi Flights are each overweight by a considerable margin.

8.6.10 The methods and operations for passivation, on the lunar surface, of Shelter Systems not needed, must be determined.

TABLE 8.4 -1

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

19

INJECTION CAPABILITY TO INITIAL ORBIT 132783.

SIV-B	25700.
MARGIN & RESIDUALS	8600.
MODIFICATIONS	100.
IU	4300.

**TOTAL 38700. PAYLOAD CAPABILITY AT LAUNCH 94082.

CONFIGURATION CSM LM SHELTER

SLA	3860.
GROSS INERT WEIGHT	30569.
GROSS VARIABLE LOAD	57837.
GROSS EXPERIMENT WEIGHT	3595.
PAYLOAD ABOVE I.U.	95861.

PAYLOAD MARGIN -1779.

NOTES

80 N. MI. LUNAR PARKING ORBIT
INCLINATION 171 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 8.4 -2

AAP FLIGHT NO. 19

SPACECRAFT CSM
CARRIER LM SHELTER

DESCRIPTION	CSM	ADD-ONS	LM SHELTER	ADD-ONS	TOTAL
I DRY WEIGHT					
STRUCTURE	9784.	0.	2378.	0.	
STABILIZATION, CONTROL	188.	0.	110.	0.	
NAVIGATION, GUIDANCE	359.	0.	38.	0.	
CREW PROVISIONS	84.	0.	268.	0.	
ENVIRONMENTAL CONTROL	541.	360.	522.	400.	
DATA MANAGEMENT	400.	0.	224.	5.	
COMMUNICATION	475.	0.	168.	87.	
ELECTRIC PWR. & DISTR.	2865.	0.	2244.	836.	
PROPULSION	1253.	0.	1033.	0.	
REACTION CONTROL SYSTEM	662.	0.	217.	0.	
SLA RING	90.	0.	0.	0.	
EARTH LANDING SYSTEM	617.	0.	0.	0.	
EVA SUPPORT	0.	0.	0.	65.	
LANDING GEAR	0.	0.	476.	0.	
EXPLOSIVE DEVICES	0.	0.	46.	0.	
SCIENTIFIC EQUIPMENT	80.	0.	0.	0.	
GFE	0.	0.	393.	0.	
GROWTH MSFC	2301.	0.	1000.	0.	
TOTAL DRY WEIGHT	19699.	360.	9117.	1393.	30569.
**GROSS DRY WEIGHT					
VARIABLE LOAD					
MAIN TANK PROPELLANTS	33653.	0.	17749.	0.	
RCS PROPELLANTS	1571.	0.	308.	0.	
CREW PROVISIONS	958.	5.	249.	186.	
ECS & LIFE SUPT	251.	533.	118.	134.	
ELECTRICAL POWER	503.	0.	685.	0.	
UNUSABLE	408.	0.	526.	0.	
TOTAL VARIABLE WEIGHT	37344.	538.	19635.	320.	
**GROSS VARIABLE LOAD					57837.
**GROSS EXPERIMENT WEIGHT					3595.
TOTAL WEIGHT				92001.	
III					

TABLE 2.4-3 FOR FLIGHTS 19, 21, AND 23

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performance	Net	Mounting
1001	Lunar Scientific Survey Module	LM	Lunar Surface	980	97
1002	Moderate Drill Depth (30m)	LM	Lunar Surface	200	36
1003	Emplaced Scientific Station	LM	Lunar Surface	749	62
1004	Lunar Surveying System	LM	Lunar Surface	44	17
M011	Cytogenetic Blood Studies	No	In-Flight Requirements	0	0
M022	Red Blood Cell Survival	No	In-Flight Requirements	0	0
M050	Metabolic Cost of In-Flight Tasks	IM	Lunar Surface	16	10
M055	Time and Motion Study	IM	Lunar Surface	32	14
----	Vision Test on Lunar Surface	IM	Lunar Surface	10	7
**-----	Lunar Charged Dust Spectrometer (3)	IM	Lunar Surface	N/A	N/A
----	Laser Altimeter	IM	IM	75	22
(a) ----	* (a) Geological Equipment Package	IM	Lunar Surface	266	41
	* (a) Surface Traverse Equipment			572	56
	* (a) Ground Truth Package			70	22
*	Subsurface Probe (1.5-3M Drill)			30	24
(a) ----	Shelter Laboratory Analytical Experiment Package	IM	IM	55	19

Notes: Total net weight - 3160 pounds

Total Gross Weight - 3596 pounds

* These experiments are a part of the LSM.

(a) These experiments have been added to the NSA Proposal Guidelines Experiment List.

** This experiment was deleted from the NASA Proposal Guidance Experiment List. It is redundant with experiment #1003, E65, except for measurement of partial electrical charge.

TABLE 8.5.2
RECOMMENDED SUBSYSTEM CHANGES

CARRIER CSM (22 DAY) FLIGHTS 20, 22, 24.

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Electrical Power Supply	Add	132 kWh Deficiency due to mission extension (14 days to 22 days)	One supercritical hydrogen tank. One supercritical oxygen tank	+29.2	+526.9
Life Support	Add	35 pounds of oxygen required for mission extension (cabin leakage)	Oxygen included in the electrical system oxygen add-on	N/A	N/A

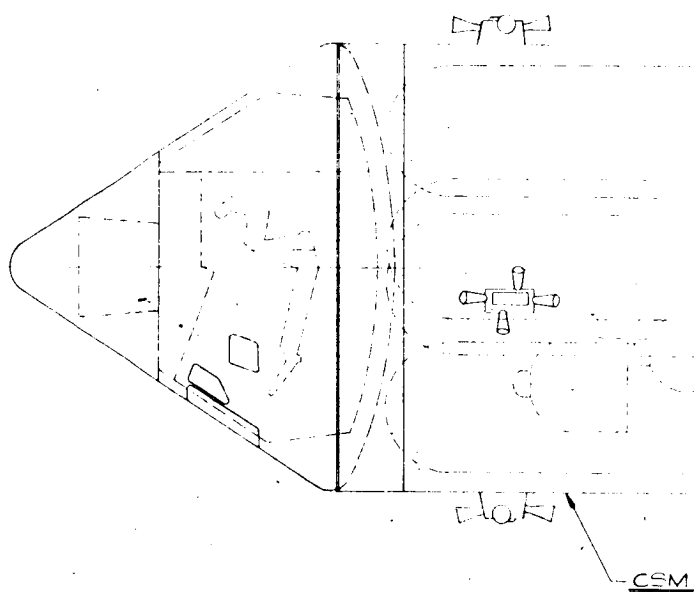
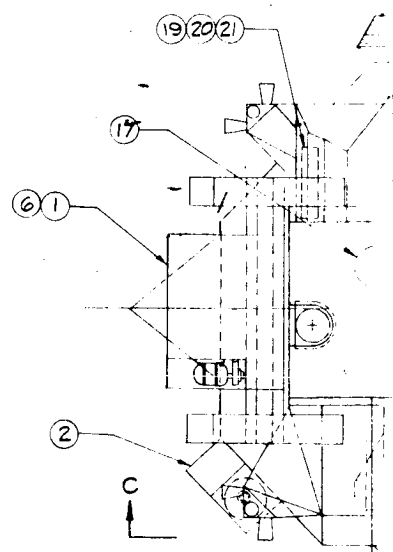
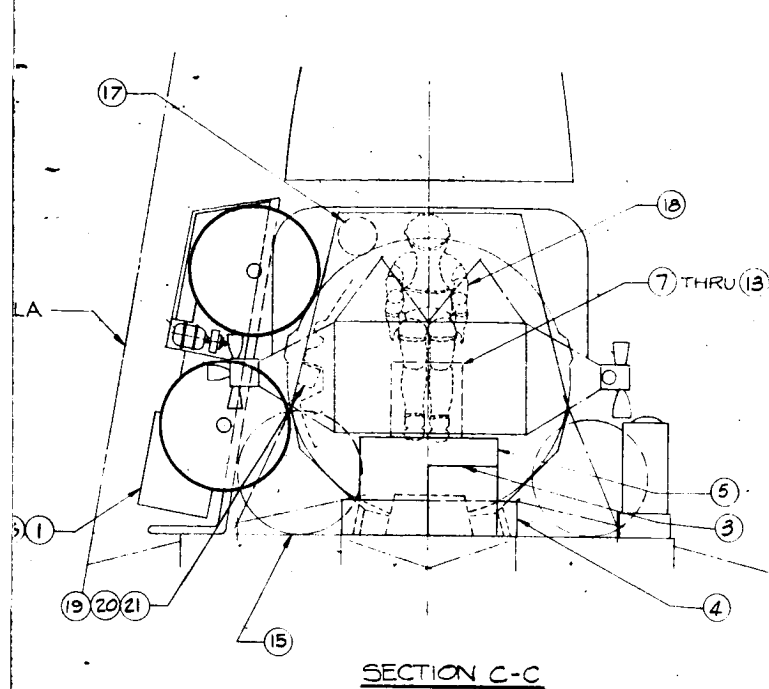
TABLE 8.5.4
RECOMMENDED SUBSYSTEM CHANGES

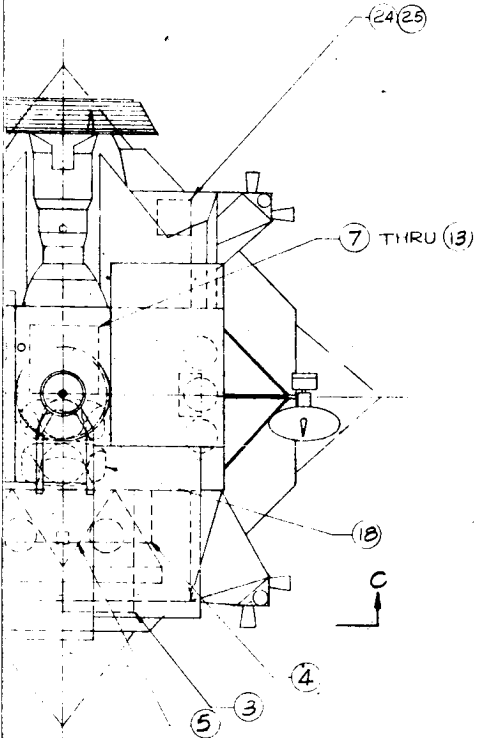
CARRIER LM SHELTER FLIGHTS 19, 21, 23

SUBSYSTEM	ACTION	REASON	COMPONENT	SIZE	WEIGHT
Electrical Power Supply	Add	Power requirements exceed capability by 253.5 KWH for the preutilization, checkout, and manned shelter phases. This amounts to an add-on of 25.4 lb of hydrogen and 163.2 lb of oxygen.	One supercritical oxygen tank.	26.6" o.d.	406 lb (wet)
			One supercritical hydrogen tank	41.5" o.d. 66" Long.	430 lb (wet)
Data Management	Add	Data recording capability required for experiments which is not included as a portion of the experiment contained instrumentation.	Voltage control oscillator(1)	.7 ft ³	14 lb
			Video recorder (1)	1.0 ft ³	70 lb
			Video switch (2)	Negl.	2 lb
Thermal Control	Add	Additional water (648 pounds) required for heat rejection (Baseline water allocation - 348 lb)	1M Ascent Water Tank	15" o.d.	53.7 lb (wet)
			1M descent water tank	20.4" o.d. X 32.5" (Pear shaped)	346 lb (wet)
Life Support	Add	Additional oxygen required for increased EVA activity	(included in electrical power supply oxygen add-on)	N/A	N/A
	Add	Additional water required for increased EVA activity	(included in thermal control water add-on)	N/A	N/A
EVA Support	Add	EVA activity and ground rule requires one hard suit for each Shelter crewman Basic capability - 1 Add-on required - 1	(1) EVA hardsuit and components	8.4 ft ³	65 lb

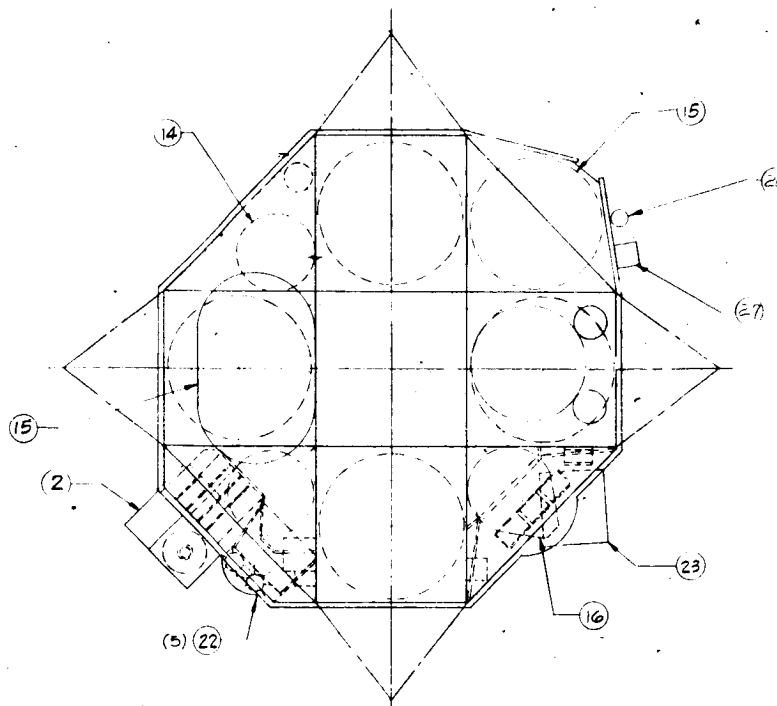
S

©

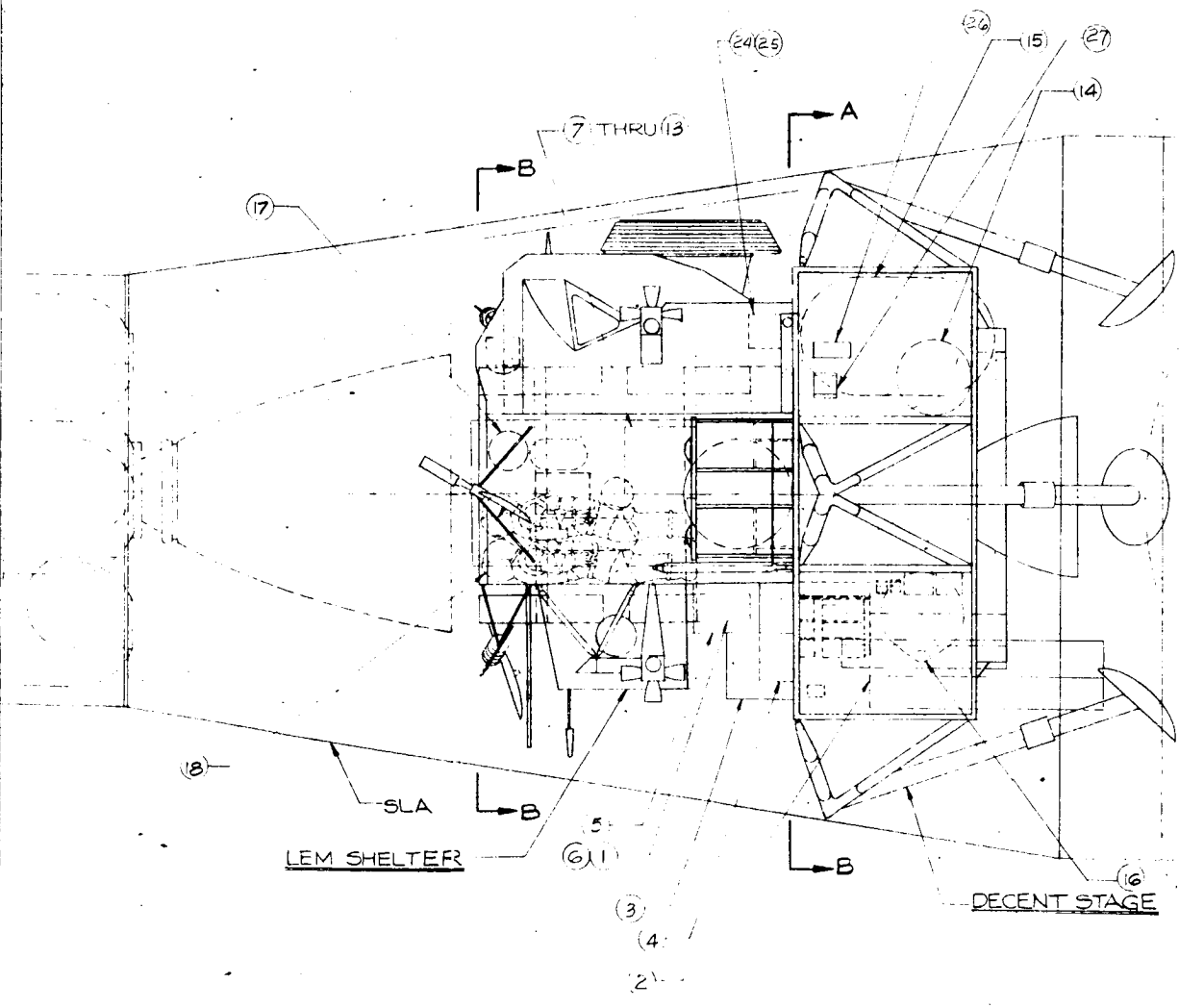




SECTION B-B



SECTION A-A



	EXP	COMPONENT
1	1001	LOCAL SCIENTIFIC SURVEY MODULE
2	1002	30 METER DRILL DEPTH
3	1003	CENTRAL STATION PACKAGE #1
4	1003	CENTRAL STATION PACKAGE #2
5	1003	CENTRAL STATION INSTRUMENT PACKAGE
6	1004	LUNAR SURVEYING SYSTEM (ON LSSM)
7		PETROGRAPHIC MICROSCOPE
8		X-RAY DIFFRACTOMETER
9		X-RAY FLUORESCENCE SPECTROMETER
10		MASS SPECTROMETER
11		NATURAL RADIATION SPECTROMETER
12		MATERIAL TESTING EQUIPMENT
13		THIN SECTION EQUIPMENT
14	SUB SYST ADD ON	CRYO O ₂ TANK
15		CRYO H ₂ TANK (2)
16		ECS WATER TANK
17		WATER TANK
18		EVA HARD SUIT
19		VOLTAGE CONTROL OSCILLATOR
20		VIDEO RECORDER
21		VIDEO SWITCH (2)
22		RTG (5)
23		LANDING ANTENNA (RELOCATED)
24	M050	METABOLIC COST OF IN FLIGHT TASKS
25	M055	TIME AND MOTION STUDIES
26		LASER ALTIMETER
27		LUNAR SURFACE VISION TESTING

NOTE:

1. SHELTER LABORATORY ANALYTICAL EXPERIMENT
PACKAGE NOT SHOWN DUE TO LACK OF INFORMATION

FIG 8-1

MARTIN MERIETTA CORPORATION
GENERAL CONFIGURATION
CSM/LEM SHELTER
FLIGHT #19, 21 & 23
MISSION #A5515, A5519 & A5524
AAP-1075

9. AAP MISSION 25/26/27/28/29

9.1 Mission Plan - This is a low earth (200 n. mi. circular-50° inclination) orbit mission using AAP Flights 25, 26, 27, 28 and 29. The General Mission Profile and Objectives are given in the General DRMD, ED-2001.

9.2 Configuration

9.2.1 Flight 25 will consist of the Saturn V launch vehicle (517) except that the S-IVB stage will be non-propulsive and outfitted on the ground to make a mission module workshop (MMWS). The orbiting payload will be the MMWS with IU, an LCSM, an AM, and a shortened MDA. See Figure 9.3.1 for vehicle configuration, experiment and commodity location, and living area allocation.

Note: The MDA is described in paragraph 4.1.9. The AM is described in paragraph 4.1.7. The 90-day CSM (LCSM) is described in paragraph 4.1.2. A preliminary weight summary for Flight 25 is presented in Table 9.4-1.

9.2.2 Flights 26, 28 and 29 will each consist of Saturn 1B launch vehicles (222, 224 and 225) and a payload of an LCSM with mission resupply as required.

9.2.3 Flight 27 will consist of a Saturn 1B launch vehicle (223) and a payload consisting of a LM Ascent Stage and a Project Thermo Rack. The rack is described in Martin document, "Experiment Requirements Document, Vol. IX, Zero-G Thermodynamics Experiments." The Configuration Profile is shown in Figure 9.3.3.

9.3 Mission Ground Rules - The ground rules and assumptions listed below were used as the guide for defining configuration and requirements of the mission.

9.3.1 The mission module workshop (MMWS) will be an S-IVB non-propulsive stage of the S-V vehicle, interfacing between the S-II stage and the Instrument Unit (IU). Maximum use of S-IVB stage structure is desired in order to reduce the costs associated with a ground outfitted space lab.

9.3.2 The forward end of the MMWS shall provide a minimum of four docking ports for two LCSMs (CSM with 90 day orbit capability), LM/Thermo/Rack and an experiment rack. The existing airlock module (AM) and the shortened Multiple Docking Adapter (MDA) shall be utilized.

9.3.3 The MMWS shall be completely outfitted and checked out prior to launch. On-orbit activation tasks shall thus be minimized. No passivation activities will be required.

9.3.4 The MMWS will provide storage capacity, living and sleeping quarters, exercise areas, laboratory facilities for conducting experiments, life support, and environmental controls to sustain the crew and equipment for the mission duration. The interstage area of the MMWS will be used for storage of expendables and for location of a power supply. Resupply commodities and experiment expendables shall be additionally provided by the LCSMs as required.

9.3.5 The LCSM from each flight must provide emergency crew quarters and life support provisions during the mission, and accordingly shall be tested (activated and checked out) a minimum of every seven days of orbit duration. Thermal control shall be provided to maintain the LCSM propellants (SPS and RCS) in a liquid state.

9.3.6 No experiment may be conducted or housed in the MMWS that would adversely affect full duration crew inhabitance if a single mode failure occurs.

9.3.7 Meteoroid protection will be afforded for the crew with protective shielding on the MMWS.

9.3.8 Operational activities and schedules shall give full consideration to radiation hazards and exposure limitations.

9.3.9 The IU shall not be considered as an experiment carrier.

9.3.10 Subsystem connections between the MMWS and other carriers shall not interfere with rapid hatch opening/sealing or the emergency isolation of the LCSM from other on-orbit hardware.

9.3.11 Critical subsystem status displays and hazard monitoring panels for on-orbit carriers shall be included in both the MMWS and the LCSM.

9.3.12 Temperature and hazard monitoring systems, with visual and auditory warning devices, shall be available and used to warn the crew of out-of-tolerance conditions or hazards on each on-orbit vehicle. The crew can then take appropriate action if a hazardous condition is identified.

9.3.13 Waste management and disposal systems, exercise, recreation and personal hygiene facilities shall be available in the MMWS.

9.3.14 There will be interface capability for electrical power, communications, and data interchange between the LCSM and the MMWS.

9.3.15 The MMWS shall have a reaction control system. This MMWS reaction control system shall operate from a command/watch post in the MMWS.

9.3.16 Gravity gradient stabilization shall be employed for the cluster to provide attitude control. Corrective stabilization or repositioning of the cluster, and fine attitude control during deployment of the M432 experiment (Large Space Structures) shall be provided by the MMWS or LCSM reaction control systems.

9.3.17 EVAs will be required during the mission; therefore, life support EVA umbilical outlets, provisions for PLSS, and an airlock shall be provided.

9.3.18 The life support system shall be two-gas, 5.0 psia, in all carriers except the LCSMS. (3.5 psia oxygen, and 1.5 psia nitrogen). The LCSM will operate normally at 5.0 psia 100% O₂.

9.3.19 SM Sector I volume and other volume made available in the LCSMs will be utilized for resupply commodity transport and storage. The use of a resupply module shall also be considered. Expendables and crew support requirements shall be based on a Flight 25, 26, 28, and 29 LCSM on-orbit time of 90 days each.

9.3.20 Design and operational requirements shall be constrained to permit the three crewmen to transfer from the MMWS to the LCSM in an emergency mode within ten minutes. Rapid emergency undock provisions for the LCSM are required. The LCSM will be capable of remaining in orbit for up to seven days or return crewmen to earth within six hours after undocking.

9.3.21 The LCSM power supply shall be deactivated when docked to the MDA and operating on MMWS power.

9.4 Experiments - The NASA suggested experiments, shown in the AAP Proposal Guidelines, have been assigned to the mission carriers as shown in Tables 9.4-3, 9.4-6, 9.4-9, 9.4-12, and 9.4-15.

9.5 Analysis Results - The existing capability of all mission elements was assessed and compared with projected mission requirements. The result of this assessment is summarized in the following paragraphs. Only those system areas where significant problems, (capability versus requirement) were identified are discussed.

9.5.1 Mission Module Workshop - All of the MMWS requirements for the mission duration must be provided as a basic capability, because a baseline configuration does not exist. These requirements are summarized as follows. Note: Mission RCS requirements will be provided by the LCSMs.

Electrical Power - MMWS operations require 5 KW energy average with ability to sustain a short peak load of 9 KW. The method of power generation was not selected for the mission. The estimated weight of a radioisotope powered closed Brayton cycle system was used for this report. (Tables 9.4-1 and 9.4-2.) Three Nicad batteries were also provided with a capability for emergencies of 10 minutes operation. The power system was tentatively located outside of the crew living areas.

Data Management and Communications - The following type equipment is required for MMWS data management and communication (weight in pounds):

Model 301 PCM	27.2
Model 270 Multiplexer (2)	42.2
Model 410 Multiplexer (3)	45.0
ASAP Recorder	50.2
AM Timer	22.1
Command Matrix Relay	8.2
Data Switch	4.0

Guidance and Control - MMWS G & C equipment required for auxiliary attitude control for the mission is a three-axis gyro assembly (30 lbs) and signal processing electronics (50 lbs).

Environmental Control and Life Support - The MMWS EC & LS requirements for the mission duration can be solved by addition of the following commodities and equipment. Storage and tankage are not included in the given weights (weight in pounds).

Oxygen	6370
Nitrogen	4800
Water	8640
Food	2160
Personal Hygiene	
Supplies	1080
Molecular Sieves (3)	180
Waste Systems (2)	200
Waste Storage (10)	200
Fans (12)	120
Li OH Reserve (2)	188
Air Ducts	
Cooling System 6 KW (Radiator Area 275 ft ²)	600
EVA expendables O ₂ , LiOH, Propellants	180

Miscellaneous Other Systems - Systems such as displays and controls, hazard warning, and other MMWS crew support systems were not provided to satisfy mission requirements. These systems, for purposes of mission feasibility, were assumed to exist in term of growth weights.

9.5.2 Mission LCSMS (Flights 25, 26, 28, and 29) - The mission requirements, per flight LCSM, are satisfied by the baseline LCSM capability except for RCS propellants. The following RCS propellant requirements were assumed and provided in LCSM weights for purposes of this mission feasibility assessment (weight in pounds).

Flight 25	988
Flight 26	2453
Flight 28	1713
Flight 29	1713

9.5.3 Flight 27 - The Flight 27 carrier capability is not sufficient in the following areas. System add-ons have been provided for purposes of this report.

Data Management - Project Thermo requires the following type add-on equipment to the rack (weight in pounds).

Model 301 PCM	27.2
Model 270 Multiplexer (3)	63.6
Model 410 Multiplexer (1)	15.0
Video Recorder	35.0
ATM Type Timer	22.0

Propulsion - Project Thermo acceleration requirements will have to be provided by the LCSM RCS or by a new RCS system added to the experiment rack. A propellant estimate of 4200 pounds based on existing equipment was assumed for this report.

Electrical Power - Additional power capability must be added to the flight to support the LCSM during Project Thermo performance.

9.6 Problem Areas - The following types of problems must be solved before the feasibility of this type of mission can be assured.

9.6.1 Selection of a Method of Power Generation for Long Duration Missions.

9.6.2 Selection of Methods for Maintenance of Astronaut Condition and Physical Fitness for Long Duration Zero-G Missions.

9.6.3 Optimization of The Experiment Payload for This Type of Mission Such as the Addition of Experiments Such as APP "A" or APP "B".

9.6.4 Integration of Project Thermo so that Experiment and Operational Requirements are Compatible in Terms of Crew Effect, Propulsion Augmentation, Attitude Control, Mission Safety, Mission Carrier and Experiment Geometry, and Power Provision.

9.6.5 Selection of a Thermal Control System That Can Operate Continuously with High Reliability and Low Maintenance For the Mission Duration.

9.6.6 Selection of Methods for Storing and Maintaining
Commodities for the Long Duration Mission.

9.6.7 Selection of a MMWS Design Most Compatible with Crew
and Other Operational Requirements.

9.6.8 Incorporation of EMR Experiments Into the MMWS. This
Experiment Has Not Been Successfully Arranged On or In the MMWS
Carrier.

TABLE 9.4 -1

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 25

INJECTION CAPABILITY TO INITIAL ORBIT 209700.

0.
0.
0.

**TOTAL

209699.

CONFIGURATION LC8M MMWS. AM/MDA

SLA
GROSS INERT WEIGHT 3860.
GROSS VARIABLE LOAD 120864.
GROSS EXPERIMENT WEIGHT 24824.
13338.

PAYLOAD ABOVE I.U. 162886.

PAYLOAD MARGIN

46814.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES
MMWS STRUCTURE WEIGHT INCLUDES S-IVB STAGE ,
INTERSTAGE AND MODIFICATIONS

DETAILED PAYLOAD WEIGHT STATEMENT (POUNDS)

TABLE 9.4 -2

AAP FLIGHT NO. -- 25

ED-2002-59
29 March 1967

SPACECRAFT
CARRIER

LCSCM

MMWS, AM/MDA

DESCRIPTION	LCSCM	ADD-ONS	MMWS	ADD-ONS	AM/MDA	ADD-ONS	TOTAL
I							
DRY WEIGHT							
STRUCTURE	9401.	0.	29450.	0.	5050.	0.	0.
I.U.	0.	0.	4300.	0.	0.	0.	0.
STABILIZATION & CONTROL	226.	0.	0.	0.	0.	0.	0.
NAVIGATION & GUIDANCE	440.	0.	0.	0.	0.	0.	0.
CREW PROVISIONS	84.	0.	0.	160.	0.	0.	0.
ENVIRONMENTAL CONTROL	702.	0.	0.	50.	361.	0.	0.
DATA MANAGEMENT	480.	0.	0.	39990.	1061.	0.	0.
COMMUNICATION	567.	0.	0.	545.	0.	0.	0.
ELECTRIC PWR & DISTR	3181.	0.	0.	0.	202.	0.	0.
PROPULSION	1130.	0.	0.	6790.	200.	0.	0.
RCS	1064.	0.	0.	2575.	0.	0.	0.
RETROROCKETS	1080.	0.	0.	0.	0.	0.	0.
SLA RING	90.	0.	0.	0.	0.	0.	0.
EARTH LANDING SYSTEM	617.	0.	0.	0.	0.	0.	0.
CRYOGENIC SUPPLY SYSTEM	0.	0.	0.	0.	0.	0.	0.
GFE	0.	0.	0.	0.	3898.	0.	0.
SOLAR ELECTRIC SYSTEM	0.	0.	0.	0.	500.	0.	0.
AM/S-IVB FURNISHINGS	0.	0.	0.	0.	4100.	0.	0.
SCIENTIFIC EQUIPMENT	80.	0.	0.	0.	189.	0.	0.
GROWTH MSFC	2301.	0.	0.	0.	0.	0.	0.
TOTAL DRY WEIGHT	21443.	0.	33750.	50110.	15561.	0.	120864.
**GROSS DRY WEIGHT							
VARIABLE LOAD							
MAIN PROPELLANTS	20000.	0.	0.	0.	0.	0.	0.
R C PROPELLANTS	2929.	0.	0.	0.	0.	0.	0.
CREW PROVISIONS	958.	0.	0.	0.	0.	0.	0.
ECS & LIFE SUPT	460.	69.	0.	0.	0.	0.	0.
UNUSABLE SPS	408.	0.	0.	0.	0.	0.	0.
TOTAL VARIABLE WEIGHT	24755.	69.	0.	0.	0.	0.	0.
**GROSS VARIABLE LOAD							
**GROSS EXPERIMENT WEIGHT							
III							
TOTAL WEIGHT							24824.
							13330.
							159026.

TABLE 9.4-3
EXPERIMENT LIST FOR FLIGHT #25

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
----	Biomedical Lab	MMWS-1	MMWS-1	80	23
T010	On-Board Centrifuge	MMWS-1	MMWS-1	928	68
T011	Re-entry Communications	LCSM	LCSM	506	53
----	Biology A	MMWS-1	MMWS-1	100	26
M432	Large Space Structures	AM-OUT	External	200	36
<u>EMR EXPERIMENTS</u>					
MSFC53A	Gamma-Ray Line Spectrograph	MMWS-1	MMWS-1	5000	495
MSFC53B	X-Ray Array	MMWS-1	MMWS-1	3900	386
MSFC53C	UV Stellar Inst. Stabilized Platform	MMWS-1	MMWS-1	925	92
MSFC53D	Gamma-Ray Spectroscopy	MMWS-1	MMWS-1	165	33
MSFC53E	Digitized Spark Chamber	MMWS-1	MMWS-1	140	30
MSFC53F	Low-Energy Gamma Ray	MMWS-1	MMWS-1	60	20
MSFC53GI	Impact of Extraterrestrial Dust Particles	MMWS-1	MMWS-1	2	2
MSFC53GII	Collection of Extraterrestrial Dust Particles	MMWS-1	MMWS-1	2	3

NOTES: Total Net Weight - 12028 Pounds
Total Gross Weight - 13338 Pounds

TABLE 9.4 -4

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 26

INJECTION CAPABILITY TO INITIAL ORBIT 65800.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

**TOTAL

30493.

35306.

PAYLOAD CAPABILITY AT LAUNCH

CONFIGURATION LC5M

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
21443.
7824.
578.

PAYLOAD ABOVE 1.0.

33706.

PAYLOAD MARGIN

1601.

NOTES

80 X 200 N. MI. INITIAL ORBIT
TRANSFER TO
220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 9.4 -5

AAP FLIGHT NO. 26

SPACECRAFT
CARRIER

LCSM

	DESCRIPTION	LCSM	ADD-ONS	TOTAL
I	DRY WEIGHT			
	STRUCTURE	9401.	0.	
	STABILIZATION & CONTROL	226.	0.	
	NAVIGATION & GUIDANCE	440.	0.	
	CREW PROVISIONS	84.	0.	
	ENVIRONMENTAL CONTROL	702.	0.	
	DATA MANAGEMENT	480.	0.	
	COMMUNICATION	567.	0.	
	ELECTRIC PWR & DISTR	3181.	0.	
	PROPULSION	1130.	0.	
	RCS	1064.	0.	
	RETROROCKETS	1080.	0.	
	SLA RING	90.	0.	
	EARTH LANDING SYSTEM	617.	0.	
	SCIENTIFIC EQUIPMENT	80.	0.	
	GROWTH MSFC	2301.	0.	
	TOTAL DRY WEIGHT	21443.	0.	
	**GROSS DRY WEIGHT			21443.
II	VARIABLE LOAD			
	MAIN PROPELLANTS	3000.	0.	
	R C PROPELLANTS	2929.	0.	
	CREW PROVISIONS	958.	0.	
	ECS & LIFE SUPT	460.	69.	
	UNUSABLE SPS	408.	0.	
	TOTAL VARIABLE WEIGHT	7755.	69.	
	**GROSS VARIABLE LOAD			7824.
	**GROSS EXPERIMENT WEIGHT			578.
III	TOTAL WEIGHT			29845.

TABLE 9.4-6

EXPERIMENT LIST FOR FLIGHT #26

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
T011	Re-entry Communications	LCSM	LCSM	460	51
-----	Charged Particle Spectrometer	LCSM	MMWS-1	10	7
-----	Biomedical Lab (Resupply Only)	LCSM	MMWS-1	10	7
-----	Biology A (Resupply Only)	LCSM	MMWS-1	20	11

NOTES: Total Net Weight - 500 Pounds
Total Gross Weight - 578 Pounds

TABLE 9.4 -7

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 27

INJECTION CAPABILITY TO INITIAL ORBIT 60500.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU
21946.
3847.
400.
4300.

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

30006.

CONFIGURATION NONE LM THERMO RACK

SLA
NOSE CAP
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT
4100.
1067.
13178.
8108.
2719.

PAYLOAD ABOVE 1.0U.

29173.

PAYLOAD MARGIN

833.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 9.4 -8

AAP FLIGHT NO. 27

SPACECRAFT
CARRIER

NONE
LM THERMO RACK

DESCRIPTION	LEM	ADD-ONS	RACK	ADD-ONS	TOTAL
I DRY WEIGHT					
STRUCTURE	1326.	0.	2000.	0.	
STABILIZATION, CONTROL	87.	0.	0.	0.	
NAVIGATION, GUIDANCE	289.	0.	0.	0.	
CREW PROVISIONS	103.	116.	0.	0.	
ENVIRONMENTAL CONTROL	347.	0.	0.	0.	
DATA MANAGEMENT	350.	42.	0.	0.	
COMMUNICATION	100.	0.	0.	0.	
ELECTRIC PWR. & DISTR.	213.	1000.	0.	5540.	
PROPULSION	15.	0.	0.	0.	
REACTION CONTROL SYSTEM	386.	0.	0.	750.	
SCIENTIFIC EQUIPMENT	0.	0.	0.	0.	
GROWTH MSFC	514.	0.	0.	0.	
TOTAL DRY WEIGHT	3730.	1158.	2000.	6290.	13178.
**GROSS DRY WEIGHT					
VARIABLE LOAD					
MAIN TANK PROPELLANTS	0.	0.	0.	0.	
RCS PROPELLANTS	608.	0.	0.	4200.	
CREW PROVISIONS	0.	0.	0.	0.	
ECS & LIFE SUPT	0.	0.	0.	3300.	
TOTAL VARIABLE WEIGHT	608.	0.	0.	7500.	8108.
**GROSS VARIABLE LOAD					2719.
**GROSS EXPERIMENT WEIGHT					
III TOTAL WEIGHT				24005.	

TABLE 9.4-9
EXPERIMENT LIST FOR FLIGHT #27

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
PROJECT THERMO					
M416	Mass Propellant Determination	LM/Rack	LM/Rack	250	39
M417	Liquid Interface Stability	LM/Rack	LM/Rack	350	46
M418	Boiling Heat Transfer	LM/Rack	LM/Rack	270	41
M419	Cryogenic Propellant Transfer	LM/Rack	LM/Rack	550	55
M420	Spaceborne Cryogenic Propellant Storage	LM/Rack	LM/Rack	850	65
M426	Condensing Heat Transfer	LM/Rack	LM/Rack	150	31

NOTES: Total Net Weight - 2420 Pounds
Total Gross Weight - 2719 Pounds

TABLE 9.4-10

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 28

	INJECTION CAPABILITY TO INITIAL ORBIT	65800.
SIV-B.		
MARGIN & RESIDUALS	21946.	
MODIFICATIONS	3847.	
IU	400.	
	4300.	
**TOTAL	30493.	PAYLOAD CAPABILITY AT LAUNCH
		35306.

CONFIGURATION LC5M

SLA	3860.
GROSS INERT WEIGHT	21443.
GROSS VARIABLE LOAD	7824.
GROSS EXPERIMENT WEIGHT	1050.
PAYLOAD ABOVE 1.0U.	34177.

PAYLOAD MARGIN

1129.

NOTES

80 X 220 N. MI. INITIAL ORBIT
TRANSFER TO
220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 9.4-11

AAP FLIGHT NO. 28

SPACECRAFT LCSCM
CARRIER

	DESCRIPTION	LCSCM	ADD-ONS	TOTAL
I	DRY WEIGHT			
	STRUCTURE	9401.	0.	
	STABILIZATION & CONTROL	226.	0.	
	NAVIGATION & GUIDANCE	440.	0.	
	CREW PROVISIONS	84.	0.	
	ENVIRONMENTAL CONTROL	702.	0.	
	DATA MANAGEMENT	480.	0.	
	COMMUNICATION	567.	0.	
	ELECTRIC PWR & DISTR	3181.	0.	
	PROPULSION	1130.	0.	
	RCS	1064.	0.	
	RETROROCKETS	1080.	0.	
	SLA RING	90.	0.	
	EARTH LANDING SYSTEM	617.	0.	
	SCIENTIFIC EQUIPMENT	80.	0.	
	GROWTH MSFC	2301.	0.	
	TOTAL DRY WEIGHT	21443.	0.	
	**GROSS DRY WEIGHT			21443.
II	VARIABLE LOAD			
	MAIN PROPELLANTS	3000.	0.	
	R C PROPELLANTS	2929.	0.	
	CREW PROVISIONS	958.	0.	
	ECS & LIFE SUPT	460.	69.	
	UNUSABLE SPS	408.	0.	
	TOTAL VARIABLE WEIGHT	7755.	69.	
	**GROSS VARIABLE LOAD			7824.
	**GROSS EXPERIMENT WEIGHT			1050.
III	TOTAL WEIGHT			30317.

ED-2002-59
29 March 1967

9-19

TABLE 9.4-12
EXPERIMENT LIST FOR FLIGHT #28

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
-----	Biomedical Lab (Resupply Only)	LCSM	MMWS-1	80	23
TO11	Re-entry Communications	LCSM	LCSM	460	51
-----	Biology A (Resupply Only)	LCSM	MMWS-1	100	26
-----	Gravity Gradient	LCSM	LCSM	135	30
MSFC-18	Space Plasma Probe	LCSM	LCSM	10	7
M433	Satellite Recovery	LCSM	LCSM	100	26

NOTES: Total Net Weight - 885 Pounds
Total Gross Weight - 1050 Pounds

TABLE 9.4-13

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 29

INJECTION CAPABILITY TO INITIAL ORBIT

65800.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

21946.
3847.
400.
4300.

**TOTAL

30493.

35306.

PAYLOAD CAPABILITY AT LAUNCH

CONFIGURATION LCSCM

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
21443.
7824.
741.

PAYLOAD ABOVE 1.0U.

33869.

PAYLOAD MARGIN

1438.

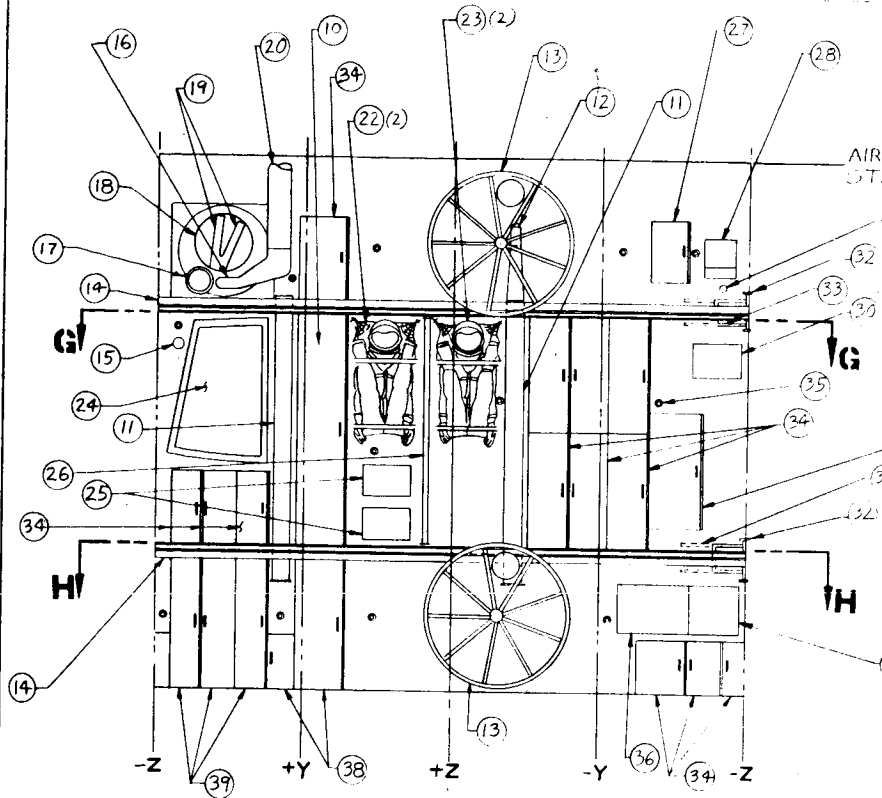
NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

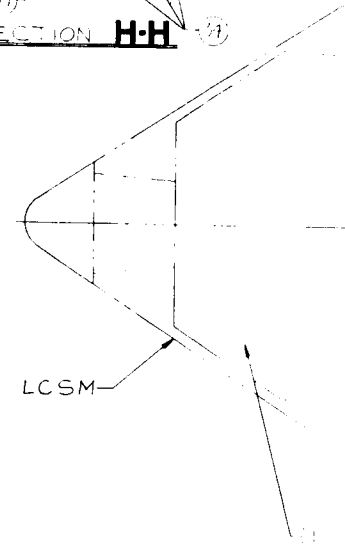
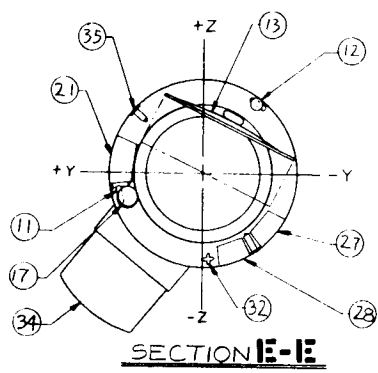
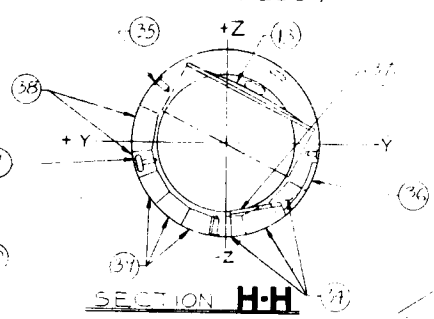
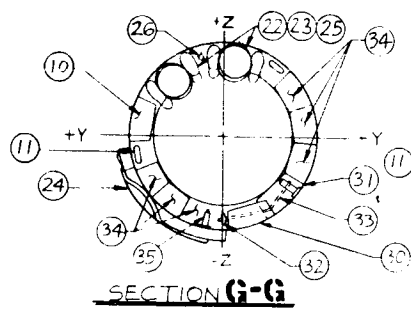
TABLE 9.4-15
EXPERIMENT LIST FOR FLIGHT #29

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
----	Biomedical Lab (Resupply Only)	LCSM	MMWS-1	80	23
----	Biology A (Resupply Only)	LCSM	MMWS-1	100	26
T011	Re-entry Communications	LCSM	LCSM	460	51

NOTES: Total Net Weight - 640 Pounds
Total Gross Weight - 741 Pounds



AM TUNNEL INTERIOR STRETCH OUT
 FOR COMPONENTS ON AM OUTSIDE OF TUNNEL, SEE
 DRAWING OF AM IN MCDONNELL REPORT NO E559



LOCK
0.0

37

51

52

5

3

59

SECTION 13-13

41 9 56 20

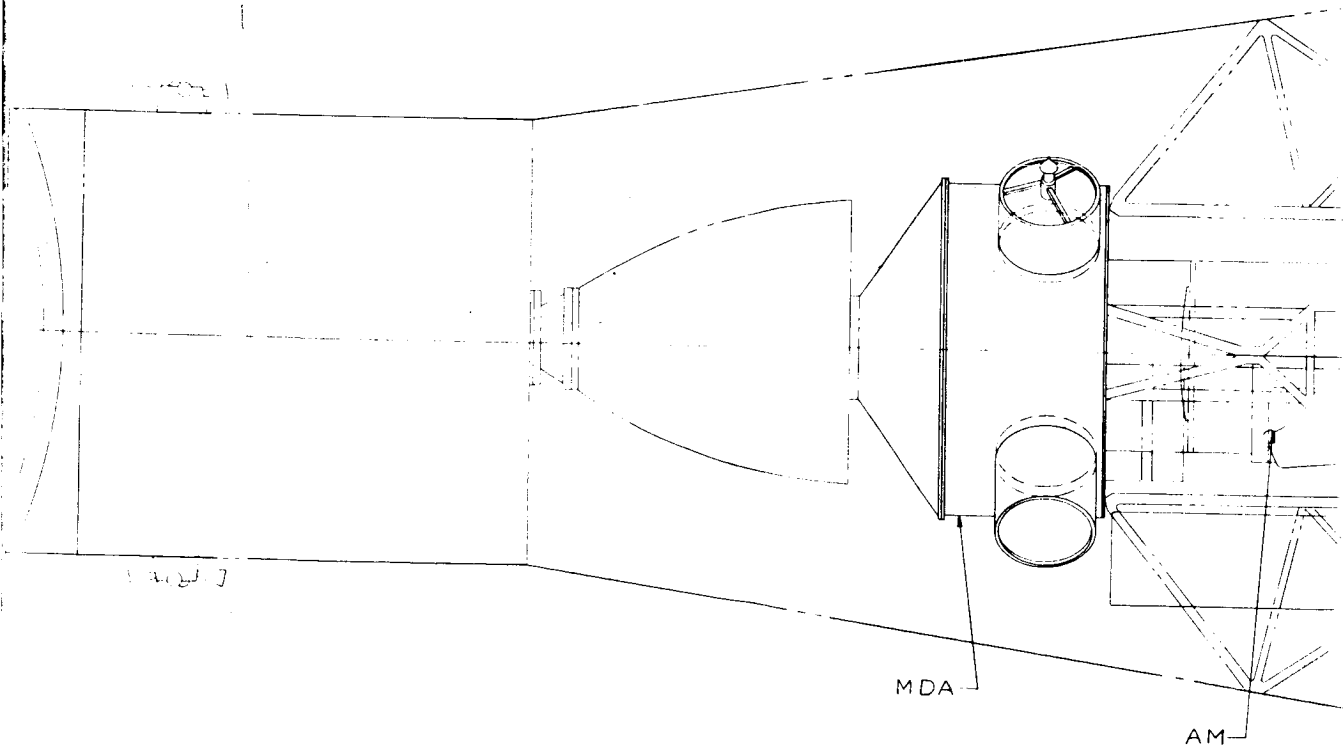
40

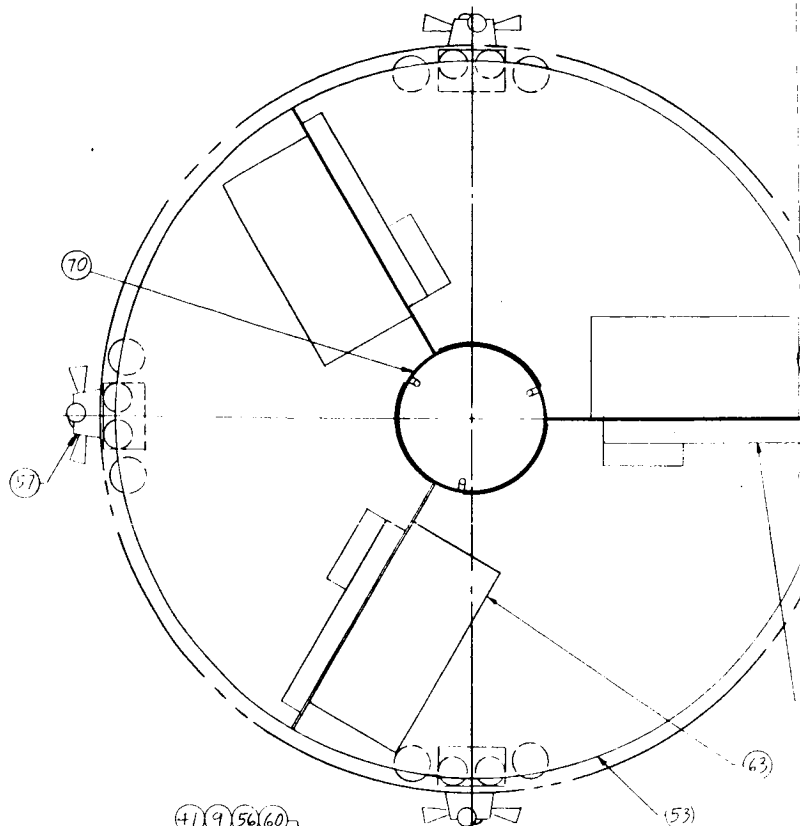
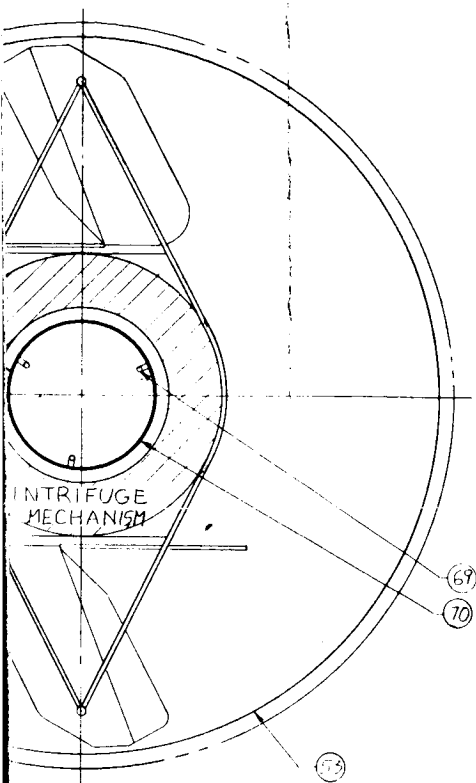
63

69

4

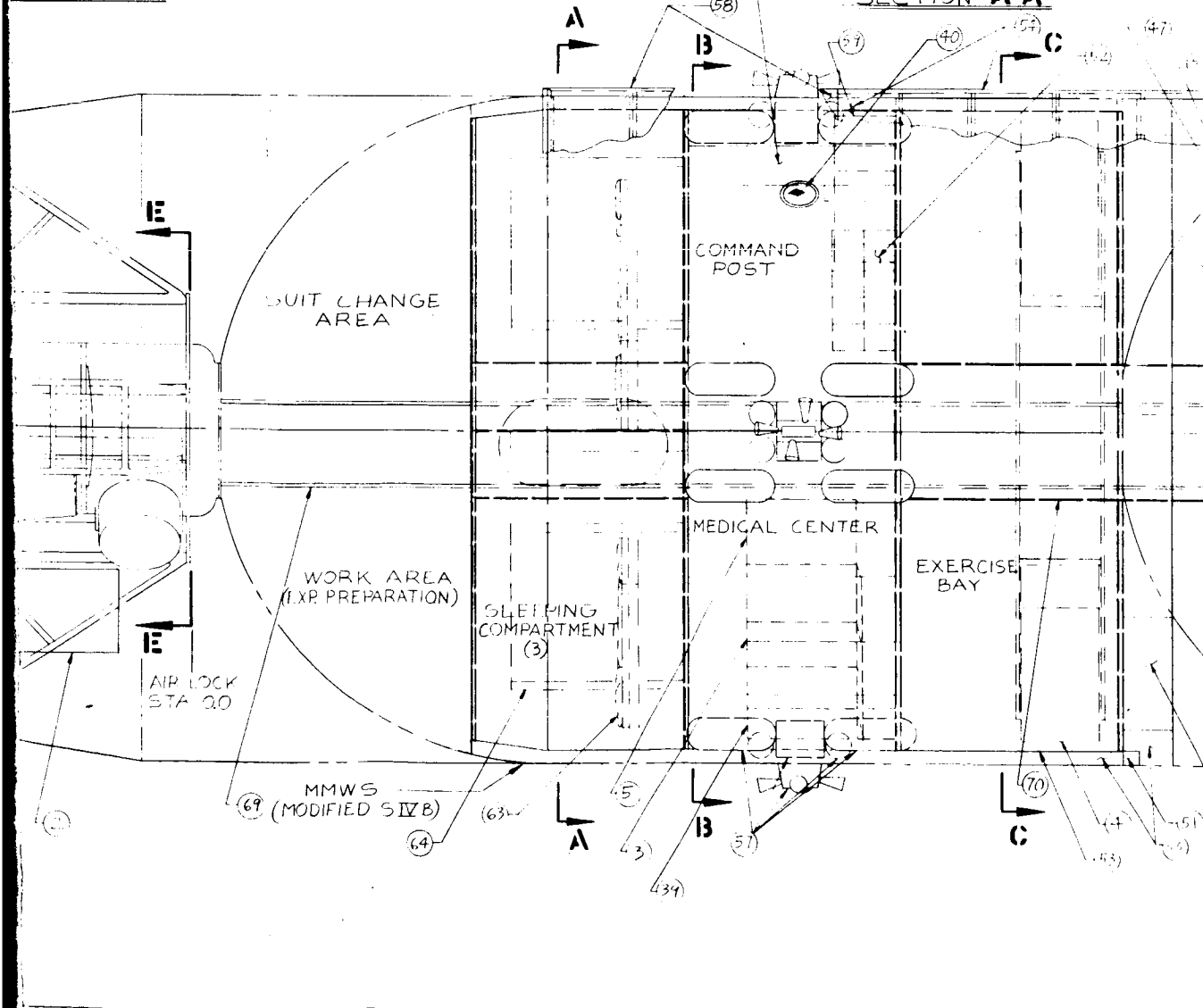
51





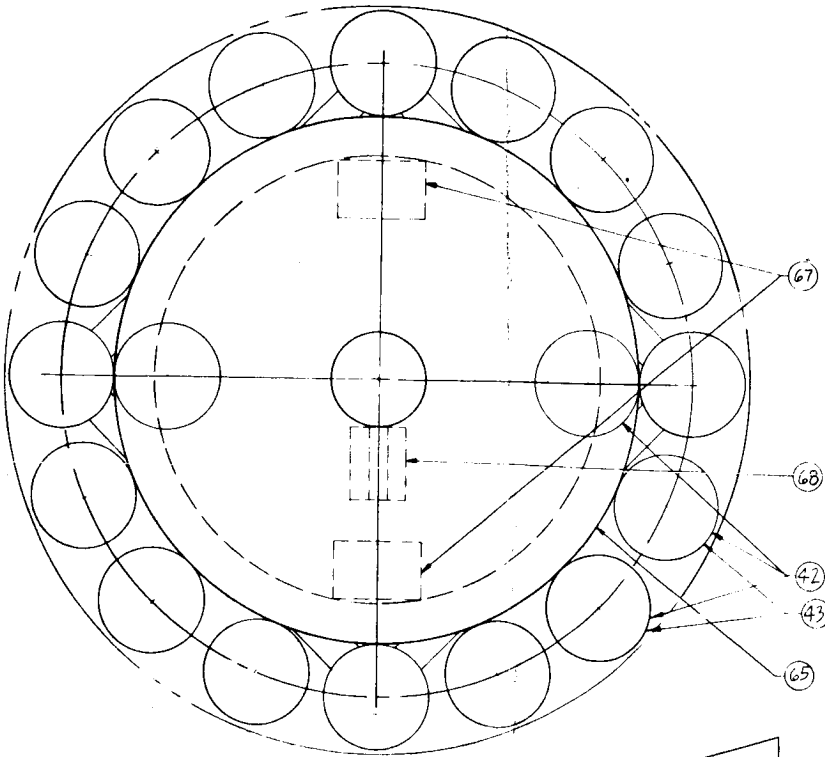
SECTION C-C

SECTION A-A



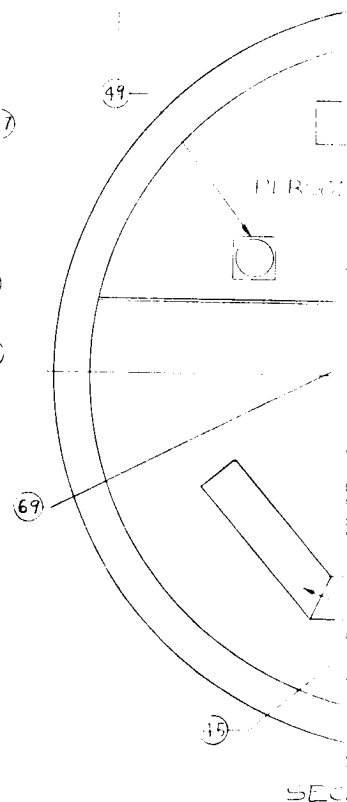
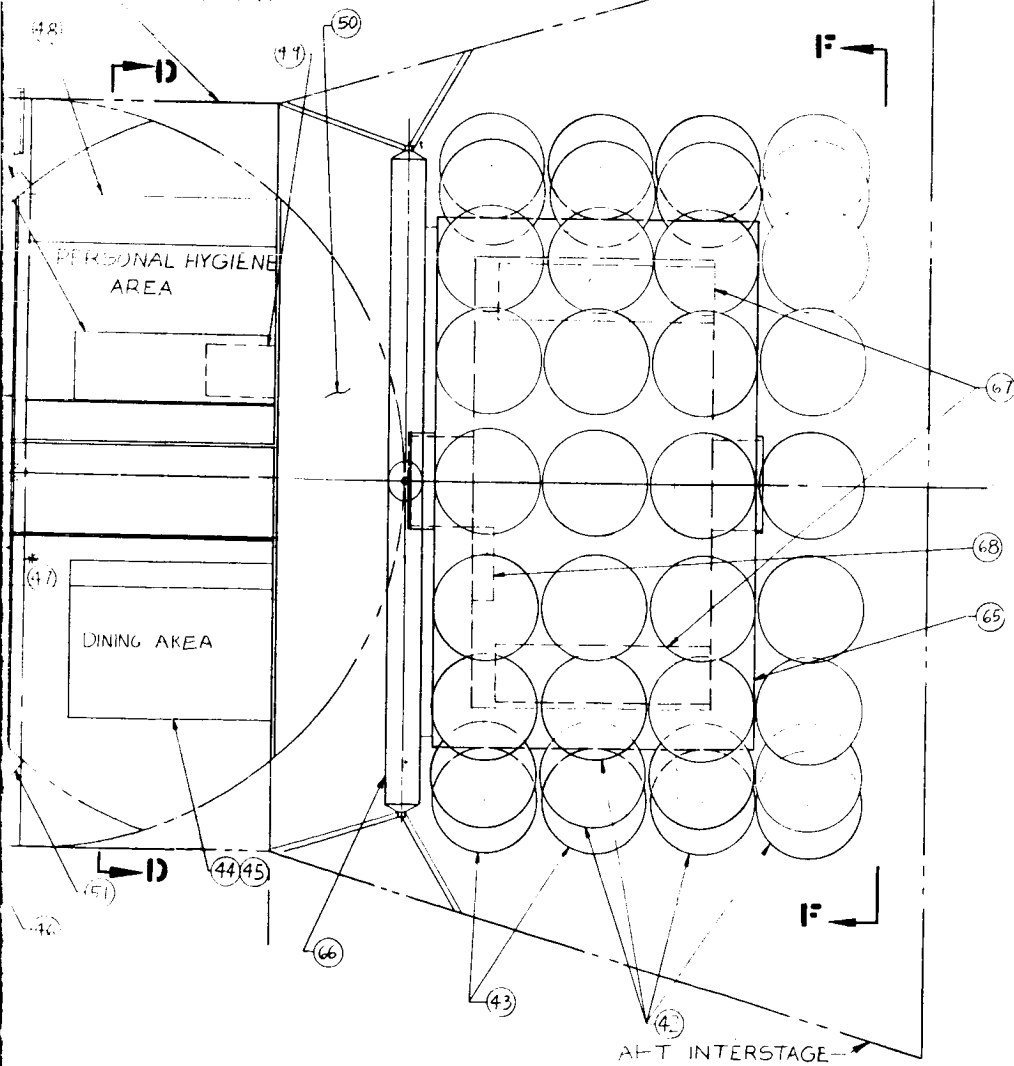
ITEM NO. LOCATION EXP. NO.

1	LC5M	TO11	RE
2	AM	M432	LAR
3	MMWS	---	BIO
4		TO10	ON
5		---	BIO
6			
7			
8			
9	MMWS	ADD ON	DAT
			TH
10	AM		EVA
11			VEN
12			FAN
13			AIR
14			DE
15			EQ
16			TUN
17			TAI
18			EC
19			SOL
20			POI
21			EC
22			NET
23			AST
24			EC
25	AM	ADD ON	CHI



AFT SKIRT

SECTION I-I



COMPONENT

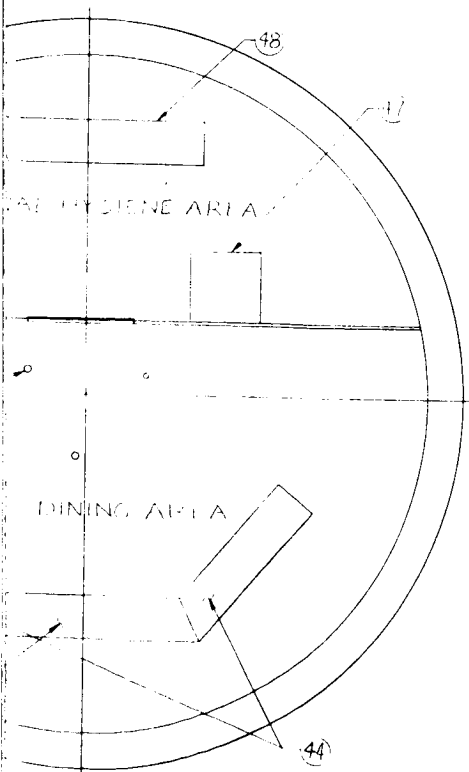
ENTRY COMMUNICATIONS
 GE SPACE STRUCTURES
 MEDICAL LABORATORY
 BOARD CENTRIFUGE
 DLOGY A

NUMBERS NOT USED

A MANAGEMENT-CONSISTS OF
 E FOLLOWING:
 MOD 301 PCM (1)
 MOD 270 (2)
 MOD 410 (3)
 ASAP RECORDER
 AM TIMER
 COMMAND MATRIX RELAY
 DATA SWITCH
 DISPLAYS & CONTROLS

8' 10" TRANSITION UMBILICAL STOWAGE
 TILATION DUCT (2)
 ASSY
 LOCK HATCH (STOWED)
 BRIS GUARD (2)
 IALIZATION VALVE
 NEL VENT VALVE
 NK
 CANISTER
 DS TRAP INLET & COMPRESSOR
 ETHYLENE DUCT
 PACKAGE COVER
 HELMET RETAINER (2)
 RONAUT SUIT STOWAGE (2)
 LOS HATCH
 ST PACK (2)

ITEM NO.	LOCATION	EXP. NO.	COMPONENT
26	AM	ADD ON	HANDRAIL
27			UTILITY LIGHT & EXTENSION CORD
28			AFT INSTRUMENT PANEL
29			OXYGEN VENT
30			CENTER INSTRUMENT PANEL AIRLOCK CONTROL
31			HHMU & SUPPLY BOTTLE SPACE TOOL & REPAIR KIT STOWAGE
32			AIRLOCK PRESSURIZATION VALVE (2)
33			HANDLE & GEARBOX ASSY
34			EXTRA STOWAGE SPACE (6)
35			LIGHT ASSY (12)
36			FORWARD INSTRUMENT PANEL
37			INSTRUMENT PANEL
38	AM		CAMERA STOWAGE
39	MMWS		MEDICAL SUPPLY STORAGE
40			WINDOW
41			COMMAND POST
42			OXYGEN & NITROGEN TANKS (48)
43			WATER TANKS (18)
44			FOOD STOWAGE
45			FOOD PREPARATION
46			MOLECULAR SIEVES
47			SHOWER
48			PERSONAL HYGIENE SUPPLY STOWAGE
49			FECAL CANISTER ASSY
50			WASTE STORAGE
51			FAN (12)
52			LION RESERVE
53			THERMAL CURTAIN
54			ECI RADIATOR
55			VENTILATION DUCTS
56			COMMUNICATIONS
57			RCS SYSTEM
58			MICROMETEOROID SHIELD
59			GUIDANCE & CONTROL 3 AXIS GYRO
60			GUIDANCE & CONTROL SIGNAL PROCESSING
61			MOLECULAR SIEVES
62			LIGHTS & FIXTURES (12)
63			BEDS (3)
64			DESK & PERSONAL SUPPLY STORAGE (3)
65			MULTIPLE MISSION MODULE
66			MULTIPLE MISSION MODULE SUPPORT RACK
67			BRAYTON CYCLE POWER SYSTEM GENERATORS
68	MMWS		BATTERIES
69	MMWS		HANDRAILS
70	MMWS		CREW MOBILITY & EQUIPMENT TRANSFER TUNNEL

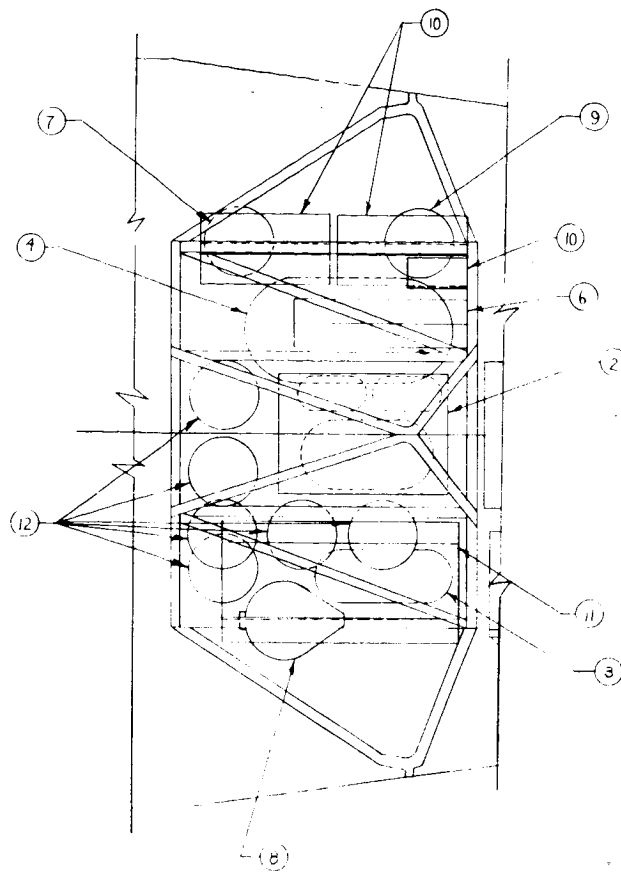


NOTES:

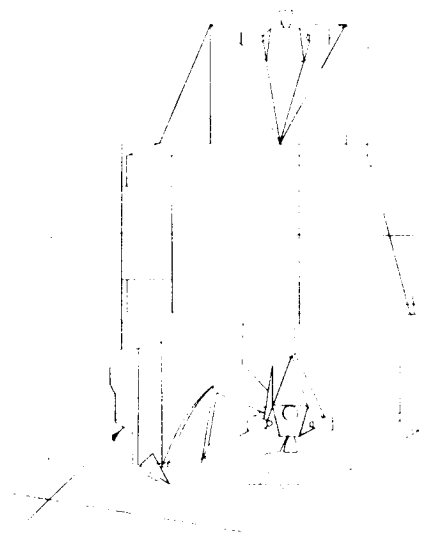
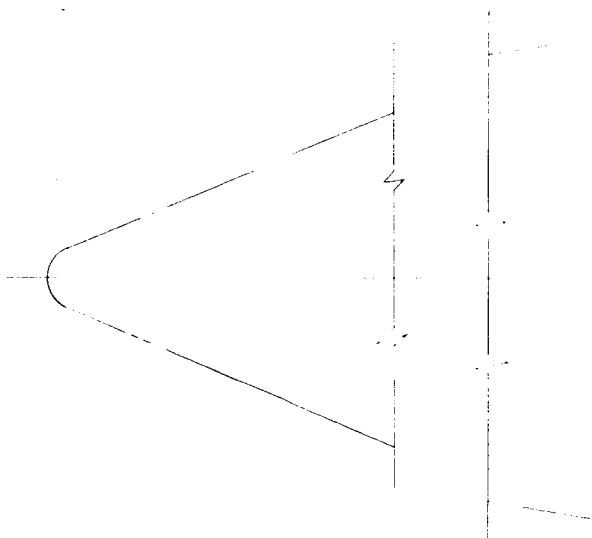
(1) (2) SHALL BE DISPERSED THROUGHOUT AS REQD

FIG 93

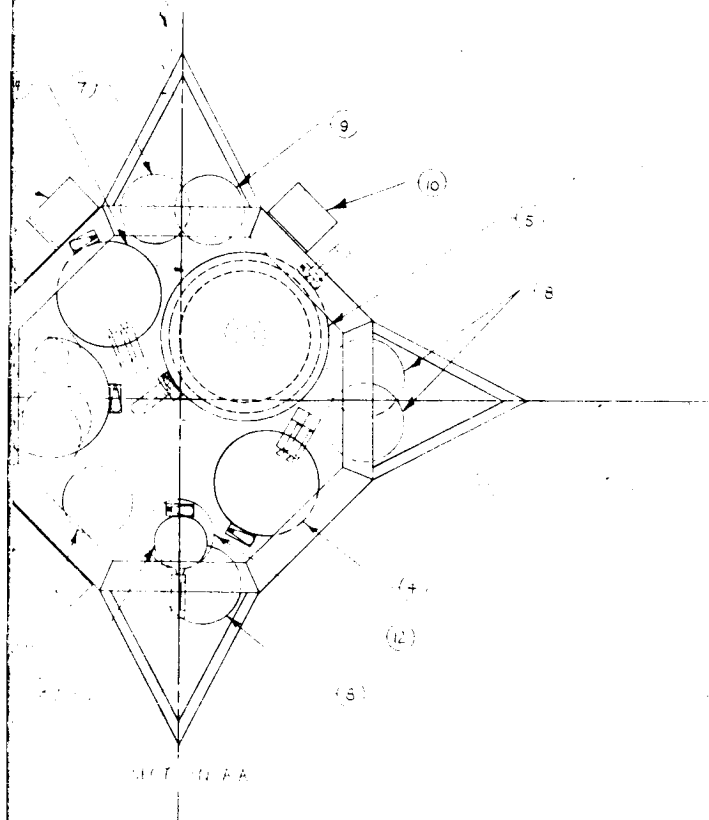
MARTIN MARIETTA CORPORATION	
GENERAL CONFIGURATION	
LCSM/MMWS/AM/MDA	
FLIGHT AAP #25, VEHICLE 517	
FIG. NO.	38507
REV.	AAP 1077
DATE	
BY	



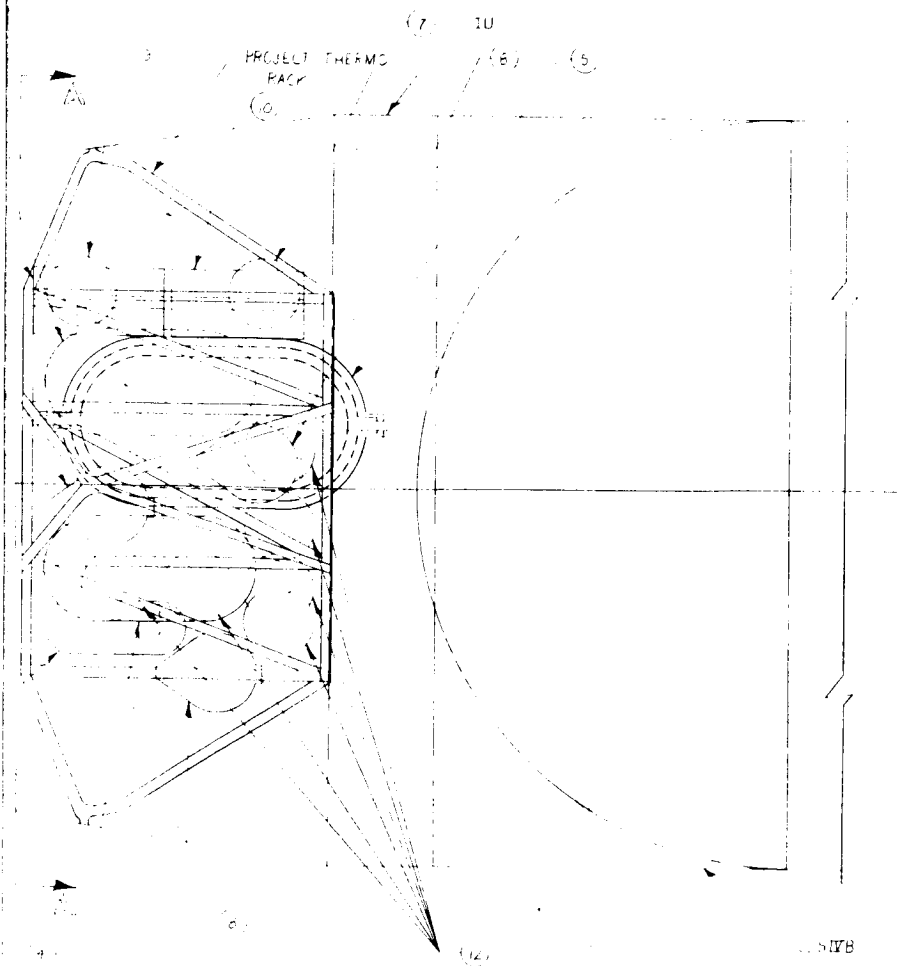
1 1 2



(3)



VIEW 11 A A



PROJECT THERMO
PACK

VIEW B

ITEM NO	EXP NO	COMPONENT	REPORT NO
1	M416	MASS PROPELLANT DETERMINATION [2] - [2] -	ED 3002-59
2	M417	LIQUID INTERNAL STABILITY [1] - [2] -	DATE 29 MARCH 1967
3	M418	BOILING HEAT TRANSFER [2] -	PAGE 9-24
4	M419	CRYOGENIC PROPELLANT TRANSFER [2] -	
5	M420	CRYOGENIC PROPELLANT STORAGE [2] -	
6	M421	CONDENSING HEAT TRANSFER	
7	OR LIST	HE TANK	
8	ADD ON	H ₂ O TANK (3)	
9		CO ₂ TANK	
10		BATTERY (5)	
11		CAMERA NO ONE WHEELS	
		MOD 1000	
		MOD 1000	
		MOD 400	
		WHEELS RECOVER	
		ATM THERM TANK	
	OR LIST	PREL. HEAT TRANSFER TANK	
	ADD ON		

NOTE:

1. EXPERIMENTS M416 & M417 USE THE SAME EQUIPMENT

2. CAMERAS, FILM, & AMAL ARE LOCATED ON THE TANKS OF EXPERIMENTS
M416, M417, M418, M419, & M420 AS SHOWN IN SECTION VIEW 4A

Fig 2.5.1

MARTIN MARIETTA CORP.
GENERAL ENGINEERING
CRYOGENIC THERMO-FLUID
SYSTEMS DIVISION
4000 17th Avenue, N.E.
Atlanta, Georgia 30329

10. AAP MISSION 30/31/32/33/34

10.1 Mission Plan - This is a low earth (220 n.mi. circular-50° inclination) orbit mission using AAP vehicles 30, 31, 32, 33, and 34 and having the mission objectives and general mission profile as given in the General DRMD, Document ED-2001.

10.2 Configuration

10.2.1 Flight 30 uses the basic Saturn V configuration except that the S-IVB stage is nonpropulsive and will be outfitted on the ground into a mission module workshop (MMWS). The orbiting payload will be the MMWS-2 with IU, an LCSM, an AM, and a shortened MDA, and has the same configuration as vehicle 517 shown in Figure 9.3.1. The MDA is described in paragraph 4.1.9. The AM is described in paragraph 4.1.7. The 90-day CSM (LCSM) is described in paragraph 4.1.2.

10.2.2 Flights 31, 33 and 34 are Saturn I-B launch vehicles each with a payload of an LCSM with resupply as required.

10.2.3 Flight 32 is Saturn I-B launch vehicle (227) with an orbiting payload of an LCSM and an experiment carrier rack as described in 4.1.6.

10.3 Mission Ground Rules - The ground rules and assumptions listed below were used in defining configuration and requirements of the mission.

10.3.1 The mission module workshop (MMWS) will be an S-IVB non-propulsive stage of the S-V vehicle, interfacing between the S-II stage and the Instrument Unit (IU). Maximum use of S-IVB stage structure is desired in order to reduce the costs associated with a ground outfitted space lab.

10.3.2 The forward end of the MMWS shall provide a minimum of four docking ports for two LCSMs (CSM with 90-day orbit capability) and a rack. The existing airlock module (AM) and the shortened Multiple Docking Adapter (MDA) shall be utilized.

10.3.3 The MMWS shall be completely outfitted and checked out prior to launch. On-orbit activation tasks shall thus be minimized. No passivation activities will be required.

10.3.4 Primary crew living quarter (shirtsleeve conditions), life support provisions, and storage for expendables for a 360-day mission shall be provided in the MMWS. However, resupply of commodities and expendables shall be in accordance with 10.3.20, and emergency provisions shall also be in accordance with 10.3.20.

10.3.5 The LCSM from each flight must provide emergency crew quarters and life support during the mission, and accordingly shall be tested (activated and checked out) a minimum of every seven days of orbit duration. Thermal control shall be provided to maintain the LCSM propellants (SPS and RCS) in a liquid state.

10.3.6 The MMWS will provide storage capacity, living and sleeping quarters, exercise areas, laboratory facilities for conducting experiments, life support and environmental controls to sustain the crew and equipment for the mission duration. The interstage area of the MMWS will be used for storage of expendables and for location of a power supply.

10.3.7 No experiment may be conducted or housed in the MMWS that would adversely affect full duration crew inhabitation if a single mode failure occurs.

10.3.8 Meteoroid protection will be afforded for the crew with protective shielding on the MMWS.

10.3.9 Operational activities and schedules shall give full consideration to radiation hazards and exposure limitations.

10.3.10 The IU shall not be considered as an experiment carrier.

10.3.11 Subsystem connections between the MMWS and other carriers shall not interfere with rapid hatch opening/sealing or the emergency isolation of the LCSM from other on-orbit hardware.

10.3.12 Critical subsystem status displays and hazard monitoring panels for on-orbit carriers shall be included in both the MMWS and the LCSM.

10.3.13 Waste management and disposal systems, exercise, recreation, and personal hygiene facilities shall be available in the MMWS.

10.3.14 There will be interface capability for electrical power, communications, and data interchange between the LCSM and the MMWS.

10.3.15 The MMWS shall have a reaction control system. This MMWS reaction control system shall operate from a command/watch post in the MMWS.

10.3.16 Gravity gradient stabilization shall be employed for the cluster to provide attitude control. Corrective stabilization or repositioning of the cluster, and fine attitude control during deployment of the M432 experiment (Large Space Structures) shall be provided by the MMWS or LCSM reaction control systems.

10.3.17 The life support system shall be two gas, 5.0 psia, in all carriers except the LCSMs. (3.5 psia oxygen, and 1.5 psia nitrogen.) The LCSM will operate normally at 5.0 psia 100% O₂.

10.3.18 Sector I volume in the LCSMs may be utilized for commodity transport and resupply articles. The use of a resupply module shall be considered also. Expendables and crew support requirements shall be based on the following:

Flight 30 LCSMs on-orbit time: 90 days.

Flight 31, 32, 33 and 34 LCSMs: 70 days.

10.3.19 Design and operational requirements shall be constrained to permit the three crewmen to transfer from the MMWS to the LCSM in an emergency mode within ten minutes. Rapid emergency undock provisions for the LCSM are required. The LCSM will be capable of remaining in orbit for up to seven days or return crewmen to earth within six hours after undocking.

10.3.20 The LCSM power supply will be deactivated when docking to the MDA is completed and after MMWS power is available.

10.4 Experiments - The NASA suggested experiments, shown in the AAP Proposal Guidelines, have been assigned to the mission carriers as shown in Tables 10.4-3, 10.4-6, 10.4-9, 10.4-12, and 10.4-15. The Tables show the experiment to be performed during each flight, launch location, and estimated experiment weights.

10.5 Analysis Results - The existing capability of all mission elements was assessed and compared with projected mission requirements. The result of this assessment is summarized in the following paragraphs. Only those system areas where significant problems, capability versus requirement, were identified are discussed.

10.5.1 Mission Module Workshop - All of the MMWS requirements for the mission duration must be provided as a basic capability because a baseline configuration does not exist. These requirements are summarized in the following paragraphs. Mission RCS requirements will be provided by the LCSMs.

Electrical Power - MMWS operations require 5 kw energy average with ability to sustain a short peak load of 9 kw. The method of power generation was not selected for the mission. The estimated weight of a radioisotope powered closed Brayton cycle system was used for this report. (See Tables 10.4-1 and 10.4-2). Three Nicad batteries were also provided, for contingencies, with a capability of 10 minutes duration. The power system was tentatively located outside of the crew living area.

Data Management and Communications - The following type equipment is required for MMWS data management and communications. (weight in pounds)

Model 301 PCM	27.2
Model 270 Multiplexer (2)	42.2
Model 410 Multiplexer (3)	45.0
ASAP Recorder	50.2
AM Timer	22.1
Command Matrix Relay	8.2
Data Switch	4.0

Guidance and Control - MMWS G & C equipment required for auxiliary attitude control for the mission is a three-axis gyro assembly (30 lbs) and signal processing electronics (50 lbs).

Environmental Control and Life Support - The MMWS EC & LS requirements for the mission duration can be solved by addition of the following commodities and equipment. Storage and tankage are not included in the given weights. (weight in pounds)

Oxygen	6370
Nitrogen	4800
Water	8640
Food	2160
Personal Hygiene Supplies	1080
Molecular Sieves (3)	180
Waste Systems (2)	200
Waste Storage (10)	200
Fans (12)	120
LiOH Reserve (2)	188
Air Ducts	--
Cooling System 6 KW (Radiator Area 275 ft ²)	600
EVA expendables O ₂ , LiOH, Propellants	180

Miscellaneous Other Systems - Systems such as displays and controls, hazard warning, and other MMWS crew support systems were not provided to satisfy mission requirements. These systems, for purposes of mission feasibility, were assumed to exist in terms of growth weight.

10.5.2 Mission LCSMs (Flights 30, 31, 32, 33, and 34) - The mission requirements, per flight LCSM, are satisfied by the baseline LCSM capability except for RCS propellants. The following RCS propellant requirements were assumed and provided in LCSM weights for purposes of this mission feasibility assessment. (weight in pounds)

Flight 30	988
Flights 31, 33, and 34	1713
Flight 32	1804

10.6 Problem Areas - The problem areas for this mission are generally described, as applicable, in paragraph 9.6 of this report.

TABLE 10.4 -1

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 30

INJECTION CAPABILITY TO INITIAL ORBIT 209700.

0.
0.
0.

**TOTAL

209699.

PAYLOAD CAPABILITY AT LAUNCH

CONFIGURATION LCMS MMWS AM/MDA

SLA
GROSS INERT WEIGHT 3860.
GROSS VARIABLE LOAD 120864.
GROSS EXPERIMENT WEIGHT 24755.
1486.

PAYLOAD ABOVE 1.U. 150966.

PAYLOAD MARGIN

58734.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

MMWS STRUCTURE WEIGHT INCLUDES SIV-B STAGE,
INTERSTAGE AND MODIFICATIONS

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 10.4 -2

AAP FLIGHT NO. 30

SPACECRAFT CARRIER	LCSM MMWS	AM/MDA	DESCRIPTION	LCSM	ADD-ONS	MMWS	ADD-ONS	AM/MDA	ADD-ONS	TOTAL
I										
			DRY WEIGHT							
			I.U.	0.	0.	4300.	0.	0.	0.	0.
			STRUCTURE	9401.	0.	29450.	0.	5050.	0.	0.
			STABILIZATION & CONTROL	226.	0.	0.	0.	0.	0.	0.
			NAVIGATION & GUIDANCE	440.	0.	0.	0.	0.	0.	0.
			CREW PROVISIONS	84.	0.	0.	160.	0.	0.	0.
			ENVIRONMENTAL CONTROL	702.	0.	0.	50.	361.	0.	0.
			DATA MANAGEMENT	480.	0.	0.	39990.	1061.	0.	0.
			COMMUNICATION	567.	0.	0.	545.	0.	0.	0.
			ELECTRIC PWR & DISTR	3181.	0.	0.	0.	202.	0.	0.
			PROPULSION	1130.	0.	0.	6790.	200.	0.	0.
			RCS	1064.	0.	0.	2575.	0.	0.	0.
			RETROCKETS	1080.	0.	0.	0.	0.	0.	0.
			SLA RING	90.	0.	0.	0.	0.	0.	0.
			EARTH LANDING SYSTEM	617.	0.	0.	0.	0.	0.	0.
			CRYOGENIC SUPPLY SYSTEM	0.	0.	0.	0.	0.	0.	0.
			AM/SIV-B FURNISHINGS	0.	0.	0.	0.	3898.	0.	0.
			SOLAR ELECTRIC SYSTEM	0.	0.	0.	0.	189.	0.	0.
			GFE	0.	0.	0.	0.	4100.	0.	0.
			SCIENTIFIC EQUIPMENT	80.	0.	0.	0.	500.	0.	0.
			GROWTH MSFC	2301.	0.	0.	0.	0.	0.	0.
			TOTAL DRY WEIGHT	21443.	0.	33750.	50110.	15561.	0.	120864.
			**GROSS DRY WEIGHT							
			VARIABLE LOAD							
			MAIN PROPELLANTS	20000.	0.	0.	0.	0.	0.	0.
			R C PROPELLANTS	2929.	0.	0.	0.	0.	0.	0.
			CREW PROVISIONS	958.	0.	0.	0.	0.	0.	0.
			ECS & LIFE SUPT	460.	0.	0.	0.	0.	0.	0.
			UNUSABLE SPS	408.	0.	0.	0.	0.	0.	0.
			TOTAL VARIABLE WEIGHT	24755.	0.	0.	0.	0.	0.	0.
			**GROSS VARIABLE LOAD							
			**GROSS EXPERIMENT WEIGHT							
			TOTAL WEIGHT							24755. 1486. 147105.

TABLE 10.4-3

EXPERIMENT LIST FOR FLIGHT #30

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
-----	Biomedical Lab	MMWS-2	MMWS-2	80	23
T010	On-Board Centrifuge	MMWS-2	MMWS-2	928	92
-----	Biology A	MMWS-2	MMWS-2	100	26
M432	Large Space Structures	AM-OUT	External	200	36
-----	1 Flame Plasma Effects	MMWS-2	--	--	--

NOTES: Total Net Weight - 1308 Pounds
Total Gross Weight - 1486 Pounds

1 No Information On This Experiment Is Available

TABLE 10.4 -4

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 31

INJECTION CAPABILITY TO INITIAL ORBIT 65800.

SIV-B
MARGIN & RESIDUALS 21946.
MODIFICATIONS 3847.
IU 400.
4300.

**TOTAL

30493.

35306.

PAYLOAD CAPABILITY AT LAUNCH

CONFIGURATION LC5M

SLA
GROSS INERT WEIGHT 3860.
GROSS VARIABLE LOAD 21443.
GROSS EXPERIMENT WEIGHT 7824.
559.

PAYLOAD ABOVE 1.0.

33687.

PAYLOAD MARGIN

1620.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 10.4 -5

AAP FLIGHT NO. 31

SPACECRAFT
CARRIER

LCSM

	DESCRIPTION	LCSM	ADD-ONS	TOTAL
I	DRY WEIGHT			
	STRUCTURE	9401.	0.	
	STABILIZATION & CONTROL	226.	0.	
	NAVIGATION & GUIDANCE	440.	0.	
	CREW PROVISIONS	84.	0.	
	ENVIRONMENTAL CONTROL	702.	0.	
	DATA MANAGEMENT	480.	0.	
	COMMUNICATION	567.	0.	
	ELECTRIC PWR & DISTR	3181.	0.	
	PROPULSION	1130.	0.	
	RCS	1064.	0.	
	RETROCKETS	1080.	0.	
	SLA RING	90.	0.	
	EARTH LANDING SYSTEM	617.	0.	
	SCIENTIFIC EQUIPMENT	80.	0.	
	GROWTH MSFC	2301.	0.	
	TOTAL DRY WEIGHT	21443.	0.	21443.
	**GROSS DRY WEIGHT			
II	VARIABLE LOAD			
	MAIN PROPELLANTS	3000.	0.	
	R C PROPELLANTS	2929.	0.	
	CREW PROVISIONS	958.	0.	
	ECS & LIFE SUPT	460.	69.	
	UNUSABLE SPS	408.	0.	
	TOTAL VARIABLE WEIGHT	7755.	69.	
	**GROSS VARIABLE LOAD			
III	TOTAL WEIGHT			7824. 559. 29826.
	**GROSS EXPERIMENT WEIGHT			

ED-2002-59
29 March 1967

10-11

TABLE 10.4-6
EXPERIMENT LIST FOR FLIGHT #31

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
T011	Re-entry Communications	CSM	CSM	506	53

NOTE: Total Net Weight - 506 Pounds
Total Gross Weight - 559 Pounds

TABLE 10.4 -7

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

32

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

INJECTION CAPABILITY TO INITIAL ORBIT

65800.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

21946.
3847.
400.
4300.

**TOTAL

30493.

35306.

PAYLOAD CAPABILITY AT LAUNCH

CONFIGURATION LC5M

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
21443.
7824.
974.

PAYLOAD ABOVE I.U.

34102.

PAYLOAD MARGIN

1205.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 10.4 -8

AAP FLIGHT NO. 32

SPACECRAFT
CARRIER

LCSM

	DESCRIPTION	LCSM	ADD-ONS	TOTAL
I	DRY WEIGHT			
	STRUCTURE	9401.	0.	
	STABILIZATION & CONTROL	226.	0.	
	NAVIGATION & GUIDANCE	440.	0.	
	CREW PROVISIONS	84.	0.	
	ENVIRONMENTAL CONTROL	702.	0.	
	DATA MANAGEMENT	480.	0.	
	COMMUNICATION	567.	0.	
	ELECTRIC PWR. & DISTR	3181.	0.	
	PROPULSION	1130.	0.	
	RCS	1064.	0.	
	RETROROCKETS	1080.	0.	
	SLA RING	90.	0.	
	EARTH LANDING SYSTEM	617.	0.	
	SCIENTIFIC EQUIPMENT	80.	0.	
	GROWTH MSFC	2301.	0.	
	TOTAL DRY WEIGHT	21443.	0.	
	**GROSS DRY WEIGHT			21443.
II	VARIABLE LOAD			
	MAIN PROPELLANTS	3000.	0.	
	R C PROPELLANTS	2929.	0.	
	CREW PROVISIONS	958.	0.	
	ECS & LIFE SUPT	460.	69.	
	UNUSABLE SPS	408.	0.	
	TOTAL VARIABLE WEIGHT	7755.	69.	
	**GROSS VARIABLE LOAD			7824.
	**GROSS EXPERIMENT WEIGHT			974.
III	TOTAL WEIGHT			30241.

TABLE 10.4-9
EXPERIMENT LIST FOR FLIGHT #32

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
----	Biomedical Lab (Resupply Only)	CSM	MMWS-2	10	7
T011	Re-entry Communications	CSM	CSM	460	51
----	Biology A (Resupply Only)	CSM	MMWS-2	20	11
----	Dielectro Phoresis for Prop. Orient.	SM	SM	350	46
MSFC 18	Space Plasma Probe	SM	SM	10	7

NOTES: Total Net Weight - 850 Pounds
Total Gross Weight - 974 Pounds

TABLE 10.4-10

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 33

INJECTION CAPABILITY TO INITIAL ORBIT 65800.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

21946.
3847.
400.
4300.

**TOTAL

30493.

35306.

PAYLOAD CAPABILITY AT LAUNCH

CONFIGURATION LCSM

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
21443.
7824.
583.

PAYLOAD ABOVE I.U.

33711.

PAYLOAD MARGIN

1596.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 10.4-11

AAP FLIGHT NO. 33

SPACECRAFT
CARRIER

LCSM

	DESCRIPTION	LCSM	ADD-ONS	TOTAL
I	DRY WEIGHT			
	STRUCTURE	9401.	0.	
	STABILIZATION & CONTROL	226.	0.	
	NAVIGATION & GUIDANCE	440.	0.	
	CREW PROVISIONS	84.	0.	
	ENVIRONMENTAL CONTROL	702.	0.	
	DATA MANAGEMENT	480.	0.	
	COMMUNICATION	567.	0.	
	ELECTRIC PWR & DISTR	3181.	0.	
	PROPULSION	1130.	0.	
	RCS	1064.	0.	
	RETROROCKETS	1080.	0.	
	SLA RING	90.	0.	
	EARTH LANDING SYSTEM	617.	0.	
	SCIENTIFIC EQUIPMENT	80.	0.	
	GROWTH MSFC	2301.	0.	
	TOTAL DRY WEIGHT	21443.	0.	
	**GROSS DRY WEIGHT			21443.
II	VARIABLE LOAD			
	MAIN PROPELLANTS	3000.	0.	
	R C PROPELLANTS	2929.	0.	
	CREW PROVISIONS	958.	0.	
	ECS & LIFE SUPT	460.	69.	
	UNUSABLE SPS	408.	0.	
	TOTAL VARIABLE WEIGHT	7755.	69.	
	**GROSS VARIABLE LOAD			7824.
	**GROSS EXPERIMENT WEIGHT			583.
III	TOTAL WEIGHT			29850.

ED-2002-59
29 March 1967

10-17

TABLE 10.4-12
EXPERIMENT LIST FOR FLIGHT #33

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
-----	Biomedical Lab (Resupply Only)	LCSM	MMWS-2	3	3
T011	Re-entry Communications	LCSM	CSM-8	506	53
-----	Biology A (Resupply Only)	LCSM	MMWS-2	10	7

NOTES: Total Net Weight - 519 Pounds
Total Gross Weight - 583 Pounds

TABLE 10.4-13

PAYLOAD
WEIGHT STATEMENT
(POUNDS)

34

INJECTION CAPABILITY TO INITIAL ORBIT

65800.

SIV-B
MARGIN & RESIDUALS
MODIFICATIONS
IU

21946.
3847.
400.
4300.

**TOTAL

30493.

PAYLOAD CAPABILITY AT LAUNCH

35306.

CONFIGURATION LC5M

SLA
GROSS INERT WEIGHT
GROSS VARIABLE LOAD
GROSS EXPERIMENT WEIGHT

3860.
21443.
7824.
229.

PAYLOAD ABOVE 1.0U.

33357.

PAYLOAD MARGIN

1950.

NOTES

220 N. MI. CIRCULAR ORBIT INCLINATION 50 DEGREES

DETAILED PAYLOAD WEIGHT STATEMENT
(POUNDS)

TABLE 10.4-14 AAP FLIGHT NO. 34

SPACECRAFT
CARRIER

LCSM

		DESCRIPTION	LCSM	ADD-ONS	TOTAL
I	DRY WEIGHT	STRUCTURE	9401.	0.	
		STABILIZATION & CONTROL	226.	0.	
		NAVIGATION & GUIDANCE	440.	0.	
		CREW PROVISIONS	84.	0.	
		ENVIRONMENTAL CONTROL	702.	0.	
		DATA MANAGEMENT	480.	0.	
		COMMUNICATION	567.	0.	
		ELECTRIC PWR & DISTR	3181.	0.	
		PROPULSION	1130.	0.	
		RCS	1064.	0.	
		RETROCKETS	1080.	0.	
		SLA RING	90.	0.	
		EARTH LANDING SYSTEM	617.	0.	
		SCIENTIFIC EQUIPMENT	80.	0.	
		GROWTH MSFC	2301.	0.	
		TOTAL DRY WEIGHT	21443.	0.	21443.
		**GROSS DRY WEIGHT			
II	VARIABLE LOAD	MAIN PROPELLANTS	3000.	0.	
		R C PROPELLANTS	2929.	0.	
		CREW PROVISIONS	958.	0.	
		EC5 & LIFE SUPT	460.	69.	
		UNUSABLE SPS	408.	0.	
		TOTAL VARIABLE WEIGHT	7755.	69.	
		**GROSS VARIABLE LOAD			
III	TOTAL WEIGHT	**GROSS EXPERIMENT WEIGHT			7824.
					229.
					29496.

TABLE 10.4-15
EXPERIMENT LIST FOR FLIGHT #34

Experiment Number	Experiment Title	Location		Weight (Pounds)	
		Launch	Performed	Net	Mounting
----	Biomedical Lab (Resupply Only)	LCSM	MMWS-2	80	23
----	Biology A (Resupply Only)	LCSM	MMWS-2	100	26

NOTES: Total Net Weight - 180 Pounds
Total Gross Weight - 229 Pounds

11. AAP MISSION 37

11.1 Mission Plan - The interplanetary mission (Voyager) primary objective is to obtain scientific data on Mars. It consists of six (6) basic flight operations as shown in the General DRMD, ED-2001. These operations are discussed in the following sub-paragraphs.

11.1.1 Launch and Parking Orbit Operations - The S-V (Vehicle 37) first and second stage will lift the interplanetary payload to an altitude of approximately 114 miles, followed by an initial burn on the S-IVB stage for payload insertion into a low-earth parking orbit. While in this parking orbit the forward portion of the shroud is jettisoned.

11.1.2 Transmars Trajectory - The S-IVB stage will be restarted after the earth parking orbit to provide necessary velocity for an interplanetary transfer trajectory to Mars. While accomplishing the interplanetary injection, the IU provides all command functions, including a sequenced separation of the payload, which is two planetary vehicles.

11.1.3 Midcourse Corrections - During the Mars trajectory, the two Planetary Vehicles perform independent midcourse maneuvers to achieve proper Mars approaches. Midcourse corrections will be programmed so that one vehicle will arrive near Mars approximately 8 days later than the other. Transit cruise time for both will take over a month.

11.1.4 Insertion into Mars Orbit - The large rocket motor on each Planetary Vehicle will be fired to inject the vehicles in different elliptical orbits about Mars (periapsis 300- to 900-mi; apoapsis 6,000- to 12,000-mi). The velocity change for orbit injection will be on the order of 6,500 ft/sec.

11.1.5 Entry and Landing - After several days surveillance in the Martian orbit, landing operations will be conducted. At an altitude of approximately 800,000 ft, the descent/landing capsule will be separated from the orbiting carrier, ballistically decelerated with a retrorocket for a proper surface impact trajectory, and deorbited into the Mars atmosphere.

Aerodynamic drag will slow the capsule from 15,000 ft/sec to 1,000 ft/sec by the time the capsule has descended to about 15,000 ft altitude. Retropulsion and/or parachute will then retard the capsule velocity to about 15 fps at touchdown. Total descent time from the 800,000 ft entry to the Martian surface will take about five minutes. The two surface laboratories will

conduct experiments on the Martian surface for only a few days but each orbiter spacecraft will remain in Mars orbit conducting scientific experiments for a duration of about a year.

11.2 Ground Rules

- a. The interplanetary flight module (Voyager) system will be specifically designed for the mission. Accordingly, subsystem capabilities, experiment integration, communications, data management, and special support equipment definitions will be accomplished by the agency/contractor responsible for the Voyager program. The integration of the Voyager interplanetary payload to the S-V space vehicle, and associated interface activities between this payload and S-IVB/IU stages shall be the extent of the AAP Payload Integrator role.
- b. The interplanetary payload shall not require any structural changes to the S-V vehicle, except for a new shroud. Changes to the IU shall be limited to minor programmer and data link modifications associated with the Voyager mission, and for reradiating payload radio signals via RF links prior to separation of the planetary vehicles.
- c. The interplanetary payload envelope shall be compatible with existing launch complex 39 facilities. Specialized ground equipment and adapters for the payload, such as sterilization and handling, shall be independent of AAP, and compatible with baseline S-V equipment.
- d. The flight 37 launch period shall be 30 days or more and the daily firing window one hour or more, which is compatible with S-V baseline launch operations.
- e. The S-V launch vehicle and planetary payload will have physical power, RF, signal, and environmental control interfaces. These interfaces shall only be at: (a) the points where the planetary vehicle adapters are attached to the shroud; (b) the coupler antenna on the shroud for reradiating payload radio signals;

and (c) the actual connectors on interconnecting electrical umbilical cables, for which specific locations are presently unidentified.

11.3 Configuration - Fig. 11.3 shows Flight 37 planetary payload. Figure 11.3-3 illustrates one of the two identical Planetary Vehicles contained in the S-V payload envelope.

As explained in paragraph 11.1, each Planetary vehicle is separated in Martian orbit into the Orbiter Spacecraft (Fig. 11.3-4) and the Descent/Landing Capsule (Fig. 11.3-5). The actual hardware soft-landed on Mars is the Surface Lab illustrated in Fig. 11.3-6.

11.4 Carrier Capabilities - The interplanetary launch capability is approximately 60,000 pounds. The 60,000 lb Flight 37 (Voyager) weight allocation contains a growth factor of approximately 4,000 lb.

Table 11.4-1 shows the weight breakdown for the mission. Existing allocations for carriers in this payload are shown in Table 11.4-2. Table 11.4-3 presents the mission experimental payload in terms of location and weight.

11.5 Flight 37 Problem Areas - As defined in paragraph 11.2a Ground Rules, the Payload Integrator's role will be limited to interface activities between the interplanetary payload (Voyager) and the S-V space vehicle. The payload fairing (shroud) design and its interface control is also included in responsibilities of the Voyager program. Identification of modifications to the IU and interface control between the IU and the payload module will therefore represent the primary AAP Integrator's tasks.

Accordingly, no major problem areas exist for the experiment allocations to respective interplanetary vehicles, the vehicle subsystems capabilities versus requirements, or for commodity and expendables, since all activities being completed by Voyager are applicable to, and are required for, the AAP Mission 37.

TABLE 11.4-1

WEIGHT STATEMENT
(POUNDS)

AAP FLIGHT NO. 37

	<u>ONE VEHICLE</u>	<u>TWO VEHICLES</u>
SPACECRAFT BUS/ORBITER	2,500	5,000
CAPSULE	5,000	10,000
EXPERIMENTS	372	744
PROPULSION	13,000	26,000
NET INJECTED WEIGHT	20,872	41,744
SHROUD ADAPTER		9,300
PROJECT CONTINGENCY		5,000
GROSS INJECTED WEIGHT		56,044

TABLE 11.4-2

PLANETARY VEHICLE MAJOR COMPONENT WEIGHTS

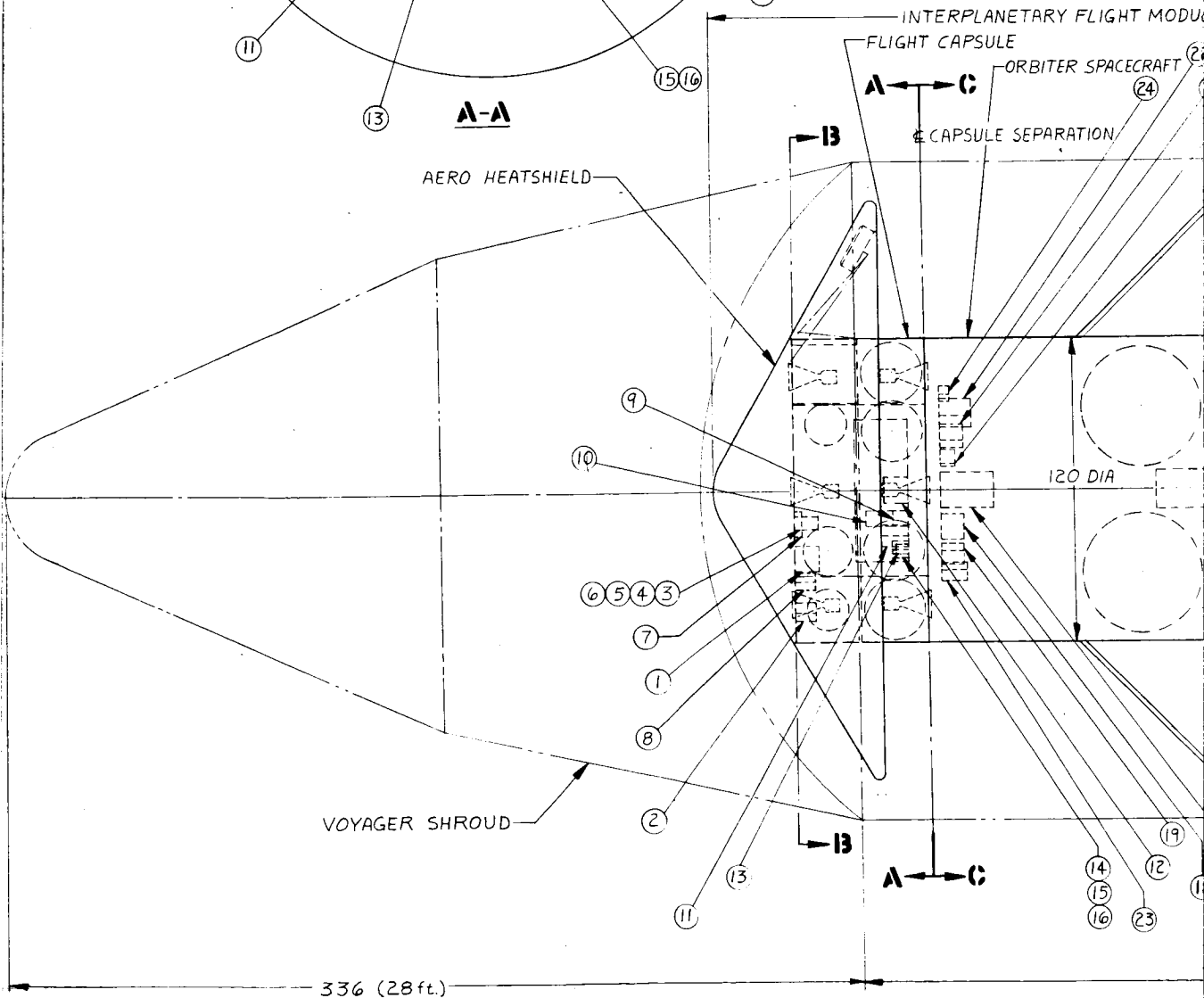
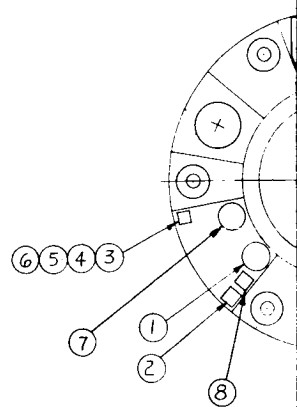
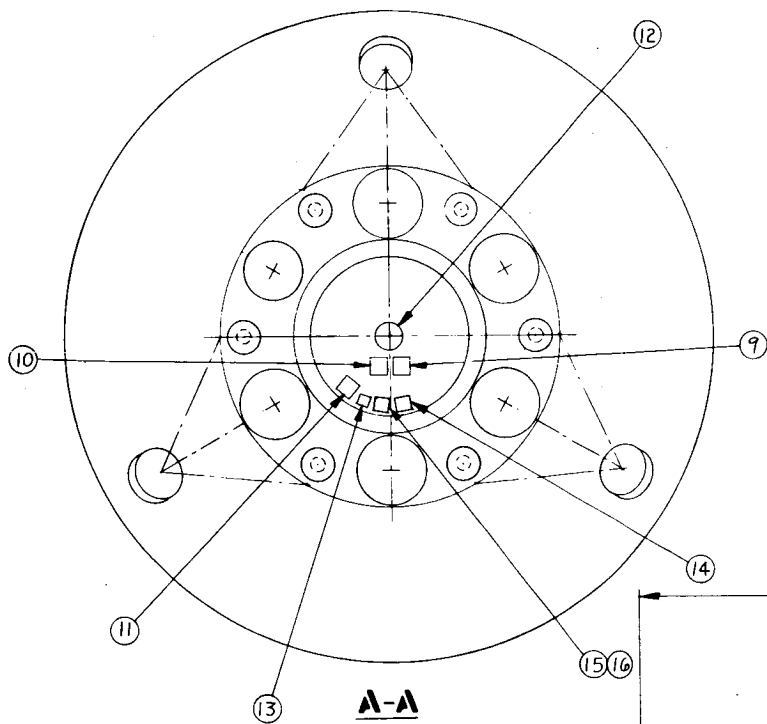
Component		Wt, Lb
<u>Orbiter Spacecraft, Total</u>		2,500
Orbiter Module		2,300
Engineering Mechanics		775
Telecommunications		340
Guidance and Control		250
Power		535
Science		400
Contingency		200
<u>Descent/Landing Capsule, Total</u>		5,000
Capsule Bus		3,140
Pre-entry Equipment	1,275	
Engineering Mechanics*	860	
De-Orbit Propulsion	415	
Entry and Landing Equipment	1,865	
Engineering Mechanics*	1,015	
Telecommunications	15	
Guidance and Control	180	
Power	90	
Propulsion	565	
Surface Laboratory		860
Engineering Mechanics*	250	
Telecommunications	70	
Guidance and Control	25	
Power	215	
Science	300	
Contingency		1,000

*Structural, thermal control, cabling and mechanism.

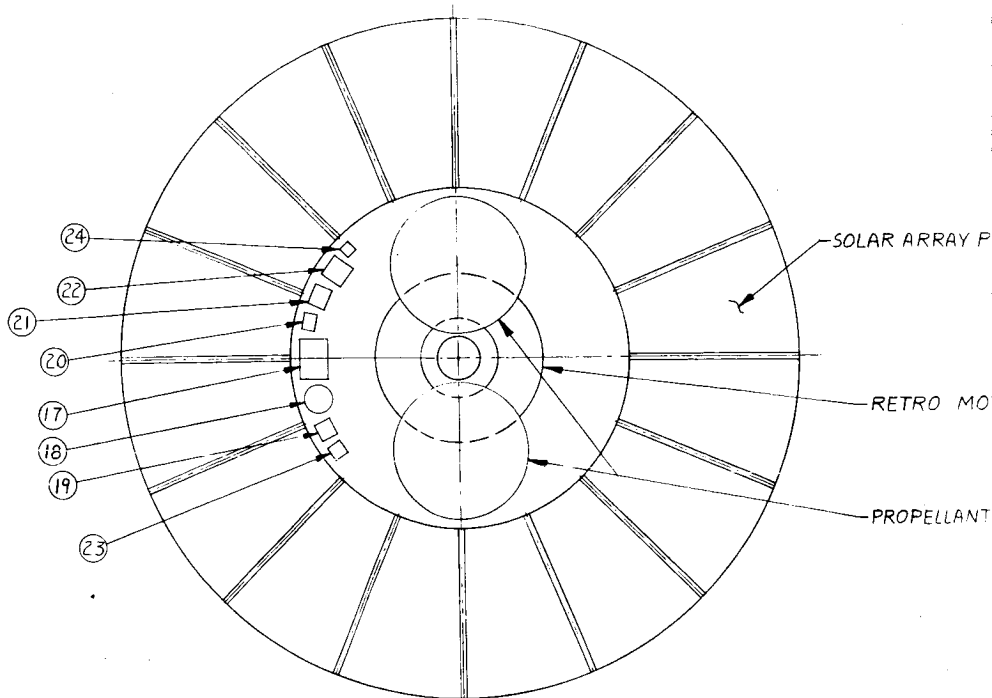
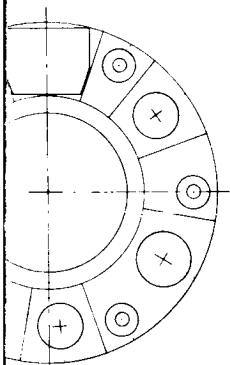
TABLE 11.4-3
EXPERIMENT LIST FOR FLIGHT #37

	Weight (Pounds)	
	Net	Mounting
FLIGHT CAPSULE EXPERIMENT SYSTEMS		
<u>Surface Laboratory System Experiments</u>		
Scan T. V.	20	11
Atmospheric Measurements	5	5
Spectro-Radiometer	6	5
Alpha-Scattering	10	7
Gas Chromatograph and Mass Spectro.	15	9
Specific Life Detectors	1	2
Particle Counters	2	2
Science Sample Acquisition and Process	30	14
<u>Entry Package Experiments</u>		
Entry T. V.	20	11
Triad Accelerometer	6	5
Pressure Transducers (2)	2	2
Temperature Probe (2)	0	1
Mass Spectrometer	4	4
Radio Meter-Analytical	2	2
X-Ray Densitometer	20	11
Radar Altimeter	10	7
FLIGHT SPACECRAFT SCIENCE EXPERIMENTS		
Flight T. V.	14	9
Magnetometer-Helium	7	6
-Triaxial Fluxgate	5	4
Plasma Probe	10	7
Microwave Radiometer	22	12
I. R. Radiometer	3	3
Ionization Chamber	1	1
Geiger Mueller Counters (10)	2	2
R. F. Occultation	Unk	Unk

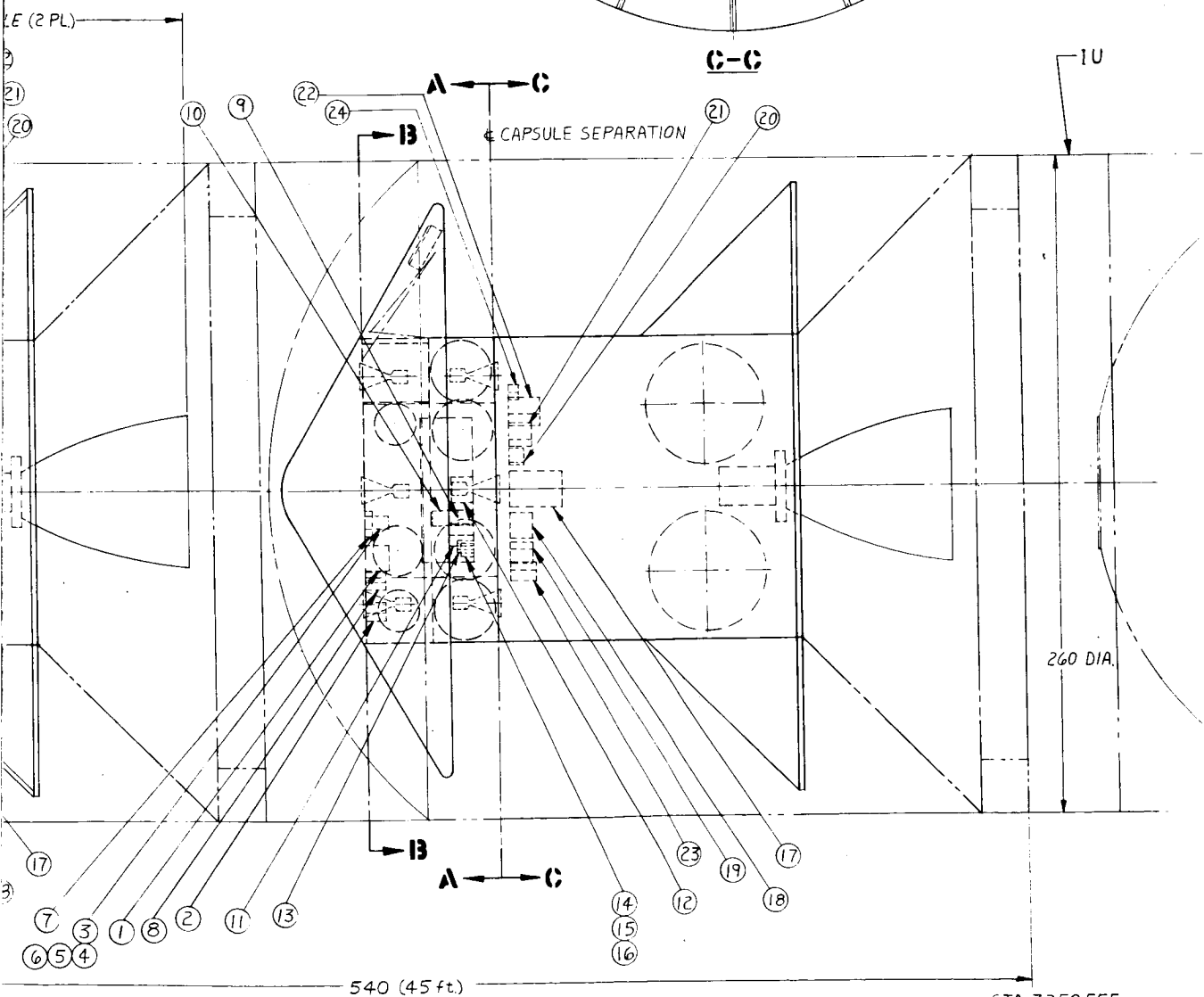
NOTE: Total Net Weight - 219 Pounds
Total Gross Weight - 372 Pounds



336 (28 ft.)



B-B



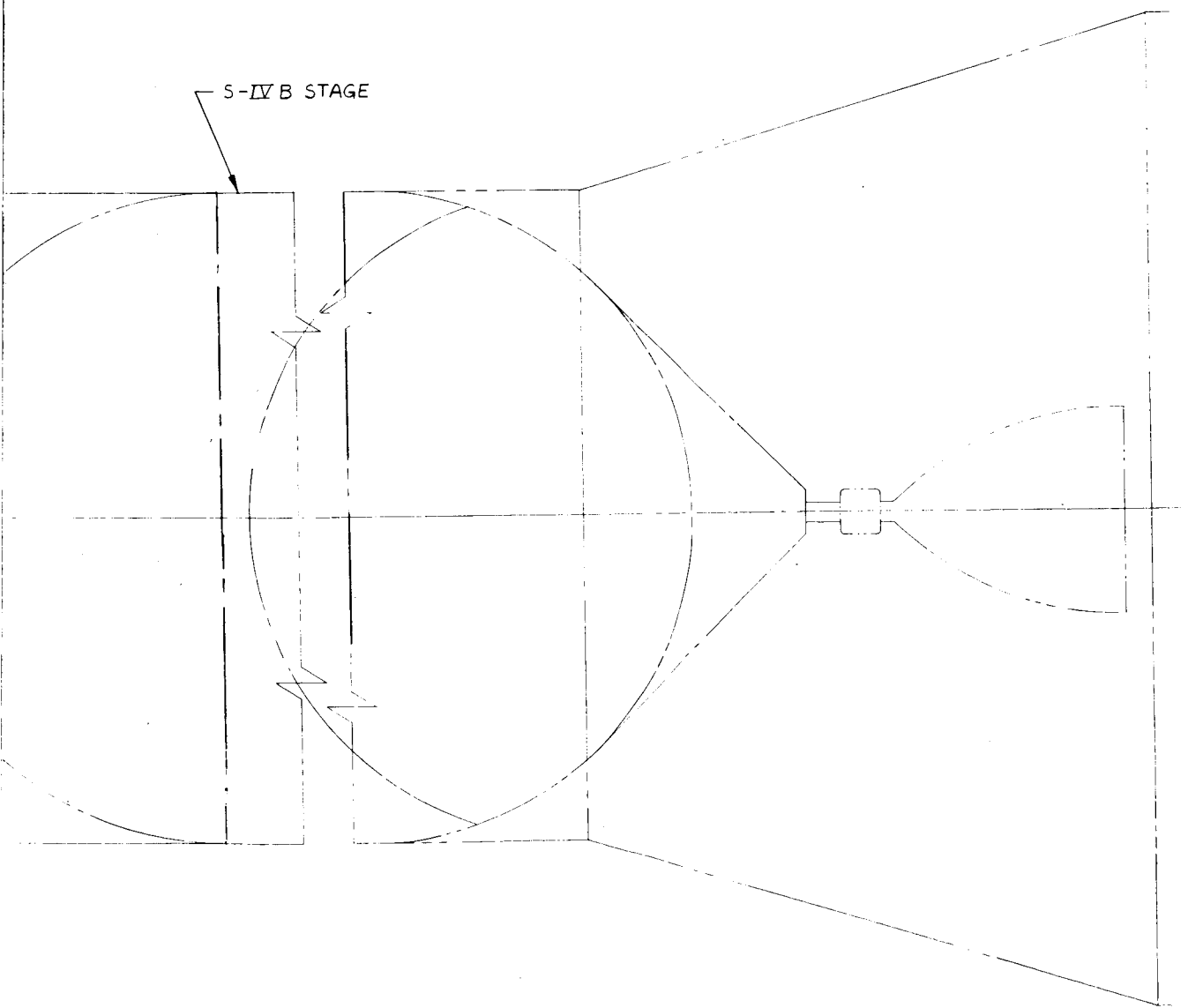
STA. 3258.555

ANELS

TOR

TANKS

S-IV B STAGE



ITEM NO.	ENTRY PACKAGE EXPERIMENTS
1	ENTRY TELEVISION
2	RADIO METER-ANALYTICAL
3	TRIAD ACCELEROMETER
4	PRESSURE TRANSDUCERS (2)
5	TEMPERATURE PROBE (2)
6	MASS SPECTROMETER
7	X-RAY DENSITOMETER
8	RADAR ALTIMETER
SURFACE LABORATORY SYSTEM EXPERIMENTS	
9	SPECTRO-RADIOMETER
10	ALPHA - SCATTERING
11	GAS CHROMATOGRAPH AND MASS SPECTROMETER
12	SCAN TELEVISION
13	SCIENCE SAMPLE ACQUISITION AND PROCESS
14	ATMOSPHERIC MEASUREMENTS
15	SPECIFIC LIFE DETECTORS
16	PARTICLE COUNTERS
FLIGHT SPACECRAFT SCIENCE EXPERIMENTS	
17	MICROWAVE RADIOMETER
18	FLIGHT TELEVISION
19	MAGNETOMETER - HELIUM
20	MAGNETOMETER-TRIAXIAL FLUXGATE
21	PLASMA PROBE
22	INFRA RED RADIOMETER
23	GEIGER MUELLER COUNTERS (10)
24	IONIZATION CHAMBER

II STAGE

FIG. 11.3

PLANETARY PAYLOAD

AAP-1073

PLANETARY VEHICLE

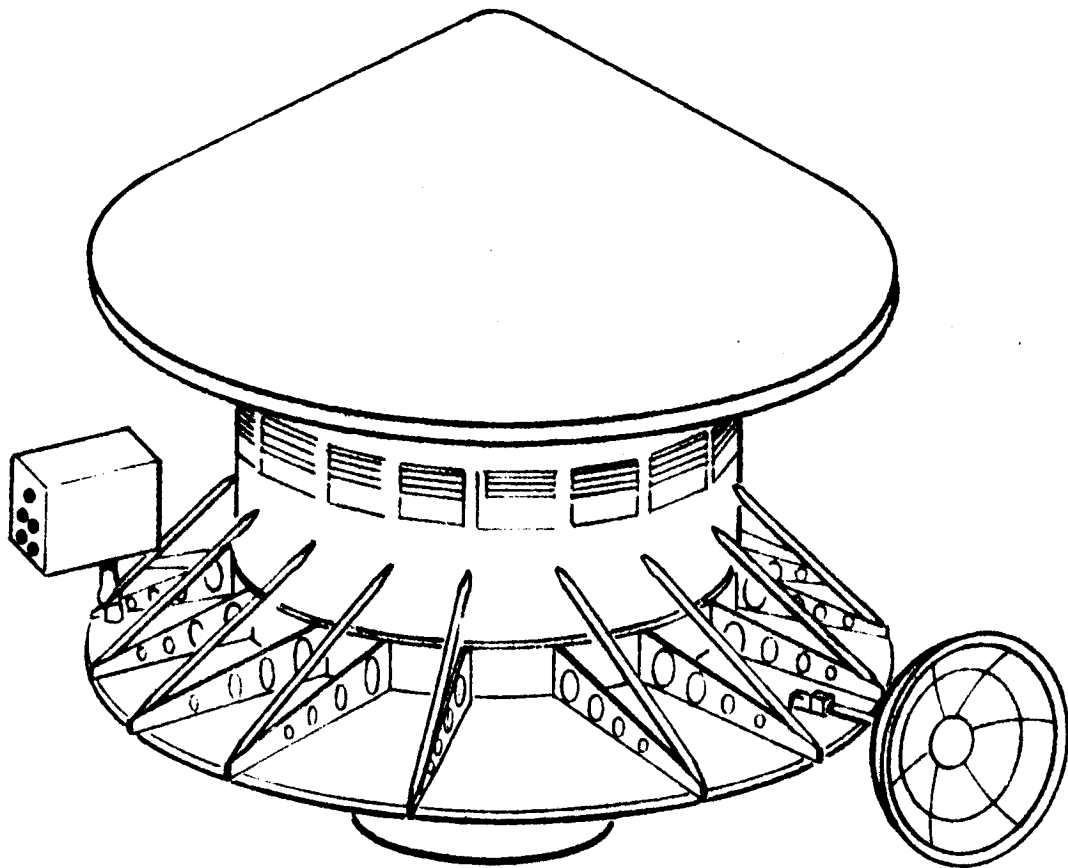


FIGURE 11.3.3

MARS ORBITOR SPACECRAFT

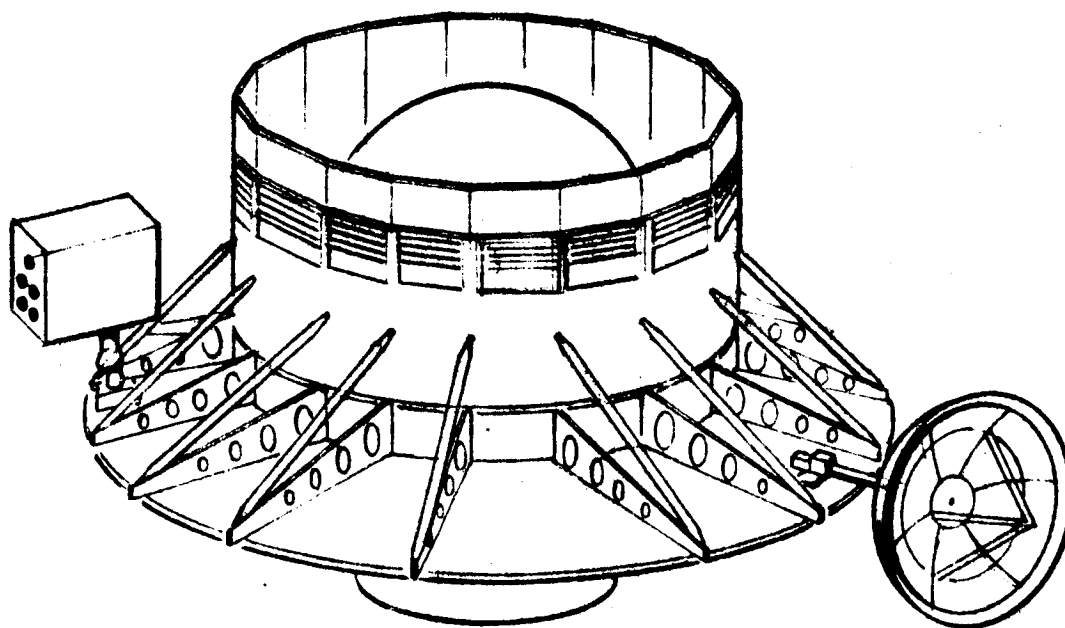
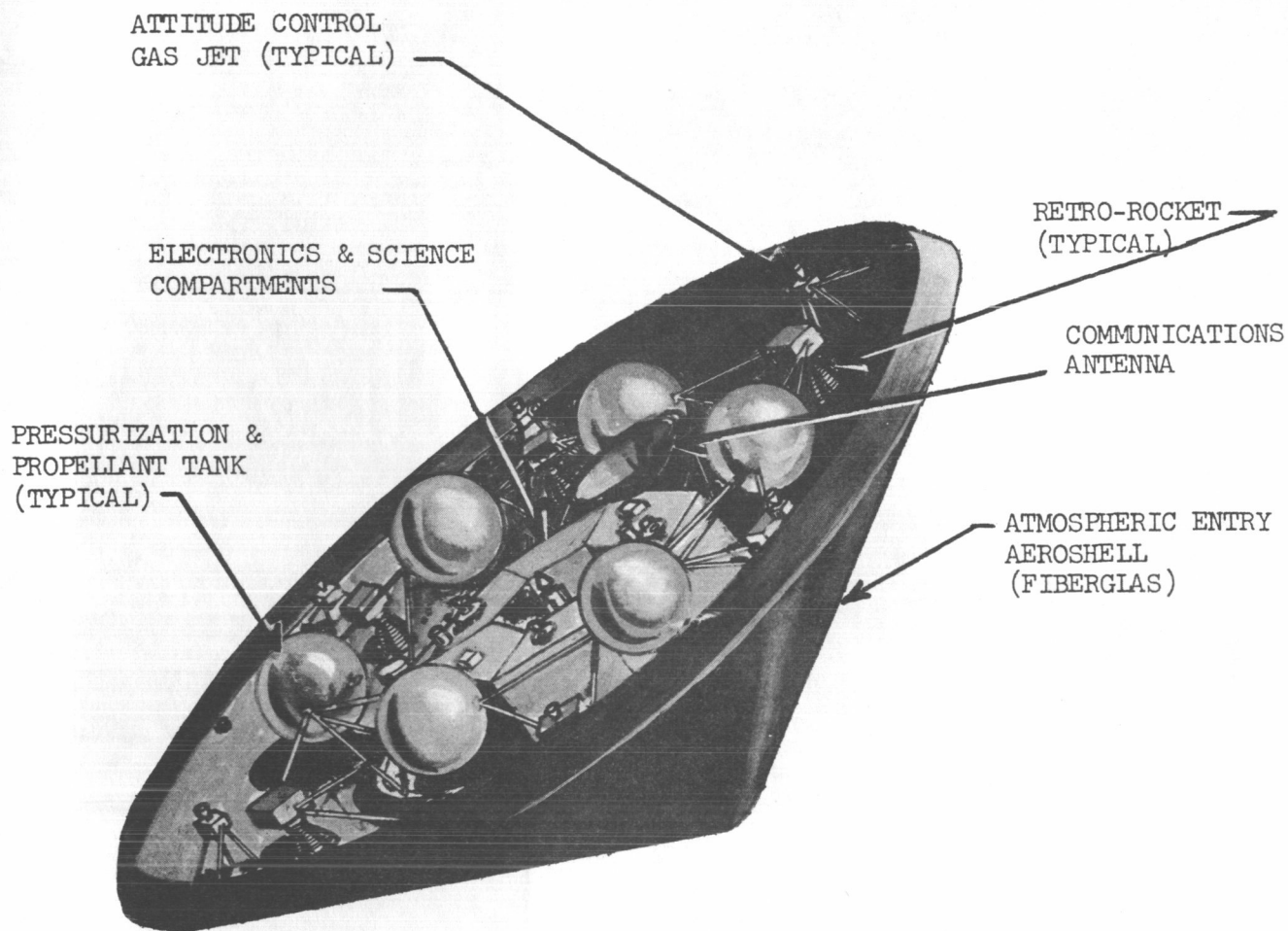


FIGURE 11.3.4



DIAMETER - - - 19 FT
HEIGHT - - - 6 FT
WEIGHT - - - 5000 LB

FIGURE 11.3.5 DESCENT/LANDING CAPSULE

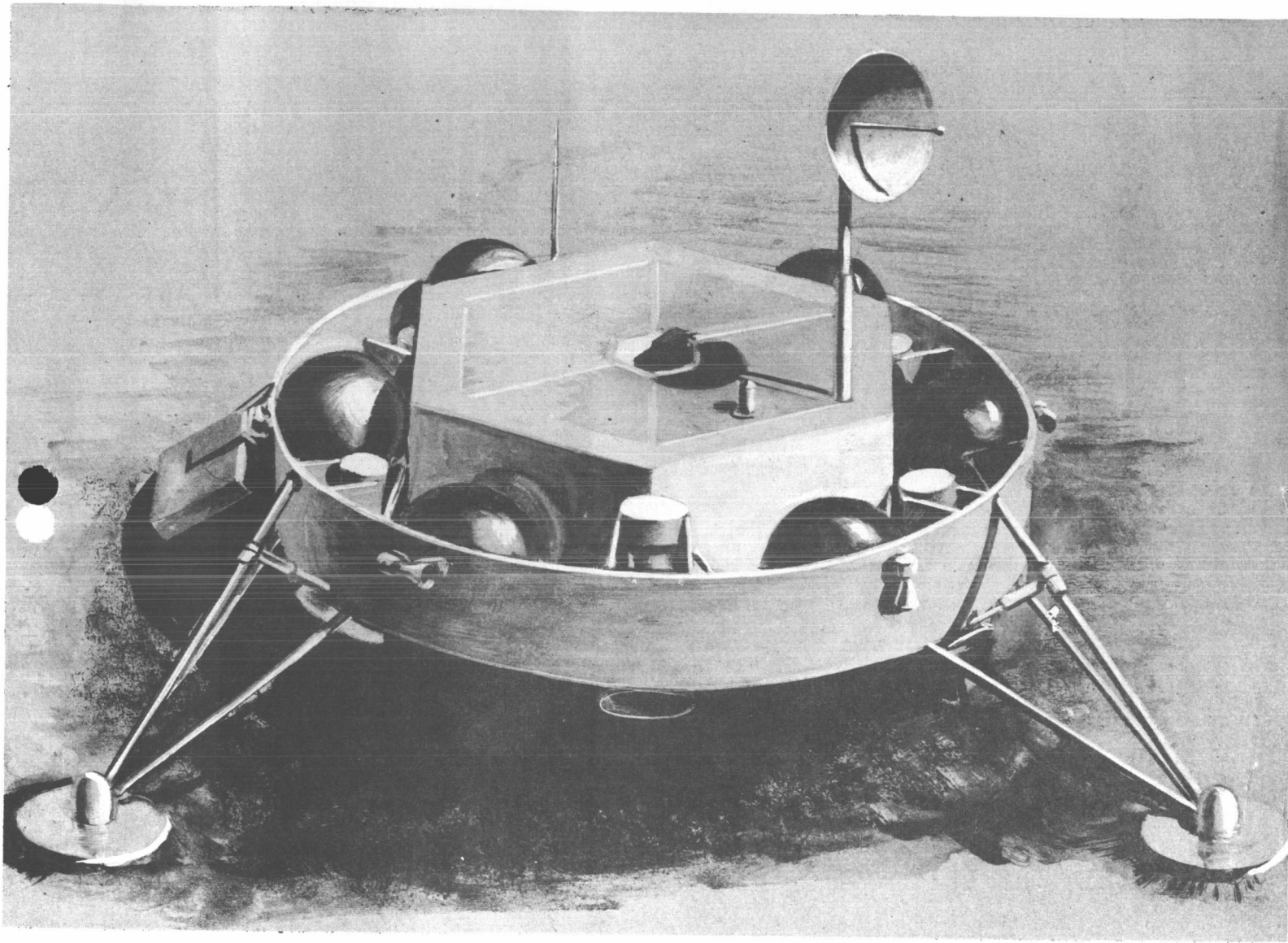


FIGURE 11.3.6 MARS SURFACE LAB